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The Under-Explored Role of Tiredness in Alcohol Use and Sexual Risk-Taking Among Gay and Bisexual Men

Brett M. Millar

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THE UNDER-EXPLORED ROLE OF TIREDNESS IN ALCOHOL USE AND SEXUAL RISK-TAKING AMONG GAY AND BISEXUAL MEN

by

BRETT M. MILLAR

A dissertation submitted to the Graduate Faculty in Psychology in partial fulfillment of the requirements for the degree of Doctor of Philosophy at the Graduate Center of the City University of New York, 2017.
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Brett M. Millar

This manuscript has been read and accepted for the Graduate Faculty in Psychology in satisfaction of the dissertation requirement for the degree of Doctor of Philosophy.

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Abstract

Numerous factors have been shown to increase the likelihood of risk-taking in the realms of alcohol use and sexual behavior — and many studies have focused on these behaviors among gay and bisexual men (GBM), given the health disparities that exist in substance use and HIV/STI infections. After a brief review of the person- and situation-level variables that have already been identified, I will argue for the relevance of also considering a previously under-explored situation-level factor in alcohol use and sexual risk-taking: sleep-related fatigue, referred to here as tiredness. While tiredness has been shown, in the sleep science literature, to impair cognition, emotion, and decision-making in a wide range of behaviors and tasks, it has yet to be considered in-depth as a risk in the realms of alcohol and sexual behavior. The role of tiredness has only received scant attention in alcohol use research as either a consequence of intoxication or a global person-level characteristic. Aside from a small number of studies on adolescent drinking, the situational influence of tiredness on alcohol use decisions and behaviors has been largely neglected. Tiredness has been even more neglected as a risk factor in relation to sexual risk-taking — perhaps due, in part, to the assumption that being tired would impede the performance of active, effortful behaviors such as drinking and having sex. However, it will be argued that, exempting severe exhaustion, more moderate levels of tiredness may actually increase the likelihood of engaging in alcohol use or sexual behavior via two pathways: one in which tiredness impairs self-regulation and thus raises the odds of engaging in a behavior, given sleep science evidence showing that tiredness peaks at night and given studies suggesting that most alcohol use and sexual behavior occur at night, and; one in which tiredness may actually motivate desire for the behavior. The evidence reviewed generates a rubric of three questions that are applied here to alcohol use and sexual risk-taking among GBM: (1) at what time of day
does the behavior occur? (2) might tiredness be motivating the behavior? (3) and are there event-level associations between sleep quality and the behavior? This dissertation analyzed three separate datasets—a brief online survey of 2,814 GBM recruited from online sites and apps, a more detailed online survey of 1,113 HIV-negative GBM, and a daily diary study of 52 HIV-positive GBM—to provide evidence in response to each of the three questions, applied to the two behaviors in turn. Both alcohol use and sex with casual partners was found to most commonly occur at night, with differences according to age and chronotype; and tiredness was shown to motivate alcohol use (both with and without energy drink mixers) and sexual desire, as well as increasing the likelihood of engaging in receptive positioning in anal sex. However, event-level associations between sleep quality and subsequent alcohol use or sexual risk-taking were not observed. These findings highlight the importance of considering tiredness as a risk factor associated with alcohol use and sexual risk-taking among GBM, with evidence indicating that tiredness impairs self-regulation while simultaneously motivating both behaviors.
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CHAPTER ONE

Introduction

The health behaviors of gay and bisexual men (GBM) remain a high priority in psychological and public health research, particularly given persistently high rates of alcohol use, HIV, and STIs in this population (Centers for Disease Control & Prevention; CDC, 2016a; Cochran & Mays, 2000). GBM report greater rates of alcohol use compared to females and heterosexual males (Kerridge et al., 2017), and this is especially evident younger GBM (Graham et al., 2011; Hatzenbuehler, Corbin, & Fromme, 2008; Marshal, Friedman, Stall, & Thompson, 2009). GBM also face disproportionately high rates of HIV, accounting for more than two-thirds of recent infections in the United States of America (USA; CDC, 2016a), and again this is particularly so for younger GBM, as those in the age ranges of 25-29 and 20-24 experience the highest rates respectively (CDC, 2016b). The primary route of HIV transmission among GBM is condomless anal sex (CAS) in the absence of sufficient use of pre-exposure prophylaxis (PrEP) by an HIV-negative partner or of treatment-as-prevention (TasP) by an HIV-positive partner—however, throughout this dissertation, sexual risk-taking is operationalized more broadly to include any CAS without attention to PrEP or TasP, in order to include STI transmission risk and to avoid the issue of whether the individual knows or assumes their partner’s PrEP or TasP status. Furthermore, the risk of infection, both for HIV and certain STIs, is markedly higher for the receptive partner in CAS (CDC, 2012; Kent et al., 2005). In sum, addressing alcohol use and sexual behavior is vital for improving the overall health of this at-risk population.

Additionally, it should be noted that addressing drug use among GBM is also important—however, this is not within the scope of the current dissertation which focuses only on alcohol use and sex, even though similar dynamics as explored here may apply to drug use.
The following sections will briefly review the numerous factors that have already been shown to increase the likelihood of risk-taking in the realms of alcohol use and sexual behavior—addressing person- and situation-level factors in turn, as well as approaches to measuring these factors—before then explaining why tiredness should also be (but has not yet sufficiently been) counted amongst them.

**Person- and Situation-Level Risk Factors in Alcohol Use and Sexual Behavior**

Studies on behaviors such as alcohol use and sexual risk-taking can generally be divided into those that have explored person-level factors (e.g., characteristics, traits) which are presumably stable for the person, and those that have explored situation-level factors which vary or fluctuate at the level of the event within the person. In relation to alcohol use in both the general population and in GBM specifically, numerous person-level factors have been identified including: younger age (Marshal et al., 2009), impulsivity (Magid, MacLean, & Colder, 2007), sensation-seeking (Hittner & Swickert, 2006; Kalichman, Tannenbaum, & Nachimson, 1998), depression (Boden & Fergusson, 2011), and alcohol-related motives such as fun, tension reduction, and social facilitation (Cooper, Russell, Skinner, & Windle, 1992; Kalichman et al., 1998; McKirnan & Peterson, 1988; Urbán, Kökönyei, & Demetrovics, 2008). In research on GBM in particular, negative affect, stress, and experiences of sexual orientation discrimination have also been shown to be associated with increased alcohol use (Hatzenbuehler, Nolen-Hoeksema, & Erickson, 2008; McKirnan & Peterson, 1988).

In relation to sexual behavior, particularly among GBM, numerous person-level factors associated with increased risk have been identified, including: younger age (Mustanski, Newcomb, Du Bois, Garcia, & Grov, 2011); impulsivity (McCoul & Haslam, 2001), depression (Fendrich, Avci, Johnson, & Macksy-Amiti, 2013; Millar, Starks, Grov, & Parsons, 2016),
sexual compulsivity (Parsons, Grov, & Golub, 2012), internalized homonegativity (Herrick et al., 2013; Millar, Wang, & Pachankis, 2016), HIV stigma (Rendina et al., 2017), rejection sensitivity (Wang & Pachankis, 2016), averaged or typical substance use (Vosburgh, Mansergh, Sullivan, & Purcell, 2012; Wells, Kelly, Golub, Grov, & Parsons, 2010), and variables such as sexual expectancies regarding the effects of substance use (Bimbi, Nanin, Parsons, Vicoso, Missildine, & Frost, 2006; Leigh, 1990; Starks, Payton, Golub, Weinberger, & Parsons, 2014; Wells, Starks, Parsons, & Golub, 2014), attachment style (Starks, Castro, Castiblanco, & Millar, 2017), and low self-efficacy for using condoms (Baele, Dusseldorp, & Maes, 2001). As will be explored in more depth later, one recent study has also identified overall levels of poor sleep quality as a risk factor for increased CAS among GBM (Duncan et al., 2016).

In addition to this emphasis on more global, enduring factors in the individual, research has also begun to consider more situation-level factors. In relation to alcohol use, these situational factors include: strength of cravings (Field, Mogg, & Bradley, 2005), fluctuating negative affect (Carpenter & Hasin, 1999; Simons, Dvorak, Batien, & Wray, 2010), and the influence of social setting and the presence of influential others (Lane, Carpenter, Sher, & Trull, 2016). Furthermore, the experience of days involving high self-regulation demands has been shown to decrease self-regulation regarding drinking alcohol (Muraven, Collins, Shiffman, & Paty, 2005). In relation to sex, situation-level factors identified by previous research include: sexual arousal or desire prior to sexual decision-making (Ariely & Loewenstein, 2006; Rendina, Millar, Dash, Feldstein Ewing, & Parsons, in press), affect prior to the sexual event (Grov, Golub, Mustanski, & Parsons, 2010; Mustanski, 2007), substance use preceding or during the sexual event (Kahler et al., 2015; Rendina, Moody, Ventuneac, Grov, & Parsons, 2015), and

For example, in Ariely and Loewenstein’s (2006) study of undergraduate males, induced sexual arousal amplified both the desire and willingness to engage in a widened range of proposed sexual activities, along with reduced consideration of moral/ethical and health-based concerns. Gailliot and Baumeister (2007) showed that, in a laboratory manipulation, both dispositionally low self-regulation and temporarily depleted self-regulation compromised participants’ capacity to exercise subsequent sexual self-regulation. Affect on a given day has been shown to be associated with subsequent sexual risk-taking among GBM in complex ways, as shown in daily diary research by Mustanski (2007) and Grov et al. (2010). Mustanski observed a complex pattern of affective states on a given day of sexual risk-taking in a daily diary study such that: sexual arousal was associated with both sexual activity and sexual risk-taking; anxious activation was associated with reduced sexual activity but with increased risk behaviors if sex was initiated, and; positive affect was associated with increased likelihood of having a sexual partner on that particular day, but with decreased risk-taking behaviors with that partner, while negative affect showed no associations. More recently, Grov and colleagues (2010) observed no association between positive affect and sexual risk-taking, but did observe increases in sexual behavior (though not risky sexual behavior) with anxious affect, and decreases in sexual risk-taking with negative affect (though less markedly so for those with sexual compulsivity). The complex interplay of affective states and subsequent risk-taking behavior requires closer consideration.

As suggested by this brief review of the extant literature, there are numerous factors that can emerge or become influential in a given situation to disrupt or diminish the individual’s
capacity to self-regulate—whether such self-regulation involves practicing moderation or delaying gratification in the face of a desired option (here, alcohol or sex). Essentially, this involves the top-down overriding of short-term desires, wants, or urges, in order to adhere to more long-term, cognitively-elaborate health goals. This struggle or battle between visceral, affectively-charged desires and more rational, cognitively-based goals or intentions is described by various dual processes models of self-regulation, such as Metcalfe and Mischel’s (1999) conceptualization of the hot vs. cool processing that determines one’s capacity to self-regulate. Such theories posit that one’s self-regulatory success is determined by the ability of one’s cool processing (e.g., rational/logical cognitions about longer term considerations) to temper or moderate one’s hot processing (e.g., emotion- or affectively-charged impulses, drives, or desires). When the latter overwhelms or overpowers the former, it is expected that self-regulation becomes more difficult and is less likely to succeed in preventing risk-taking. Within a dual processes framework, each of the previously-mentioned factors are said to either impair one’s cool processing and/or exacerbate one’s hot processing, in favor of risk-taking or short-term gratification over longer-term considerations. Further, Mischel’s (1977) emphasis on person-situation interactions highlights how the individual approaches each tempting situation with fluctuating levels of factors that can serve to either support or compromise self-regulation.

The complex influences of fluctuating factors—such as negative affect, stigma, and as it will be argued, tiredness—on risk-taking behaviors necessitate study designs that go beyond cross-sectional analyses of global, person-level factors in order to better capture the ways in which the individual varies across situations. Among various types of intensive longitudinal designs, daily diary studies have generated several insights regarding the day-by-day fluctuations in people’s behaviors, experiences, and mental health. For example, in a study where GBM
reported daily on their predictions about whether they will or will not have sex on a given day, day-level reports of subsequent behavior were used to verify the accuracy of these men’s predictions (Parsons, Rendina, Grov, Ventuneac, & Mustanski, 2015). In other studies of GBM, day-level associations have also observed between drinking motives and engagement in drinking and sex (Feinstein & Newcomb, 2017); between gay-related minority stress on a given day and affect (Eldahan, Pachankis, Rendina, Ventuneac, Grov, & Parsons, 2016); and between HIV-related minority stress and affect (Rendina, Millar, & Parsons, under review). Evidently, daily diary designs are poised to capture important day-to-day fluctuations in risk-relevant variables (Rendina, 2016; Tennen, Affleck, & Armeli, 2003).

The utility of daily diary research in studying alcohol use and sex is further bolstered by the fact alcohol use and sexual risk-taking among GBM often co-occur with, and potentially contribute to, each other (Feinstein & Newcomb, 2017; Hess et al., 2015; Kahler et al., 2015). For example, of 8,175 GBM in the National HIV Behavioral Surveillance System 2008 sample, 38.6% reported alcohol use during their most recent sexual encounter (Finlayson et al., 2011), highlighting the importance of investigating temporal links between alcohol and sexual risk-taking. Greater precision regarding the alcohol-sex link has been provided by event-level studies, utilizing timeline follow-back data (Duncan et al., 2016; Irwin, Morgenstern, Parsons, Wainberg, & Labouvie, 2006; Kahler et al., 2015; Wells, Rendina, Kelly, Golub, & Parsons, 2016) or daily diary data (Mustanski, 2008; Rendina et al., 2015; Wray et al., 2015). The event-level co-occurrence of alcohol and sex has also been observed in HIV-positive GBM (Hutton et al., 2013) and among heterosexuals (Wray et al., 2015), with associations found between heavy drinking and condomless sex. This association between drinking and sex risk was not significant in a recent study, although the association between drug use and sex risk was (Rendina et al., 2015).
In sum, understanding the person- and situation-level factors associated with alcohol use and sexual behavior among GBM remains important not only for the prevention of the known adverse physical and mental health outcomes that are directly associated with excessive alcohol use, but also for the possibility of simultaneously preventing HIV transmission. The following sections will make the case for the importance of considering a factor that has not yet been sufficiently explored in relation to alcohol use and sexual behavior—the factor of tiredness.

**Tiredness: An Under-Explored Factor**

“The continued exertion [of inhibition] quickly fatigues and it is one of the first powers to fail when the nervous system is depressed by exhaustion, disease, or the action of certain poisons.”

(Brunton, 1874, p.218)

Assertions made almost 150 years ago about the impairing effects of tiredness have received increasing empirical support in recent decades from burgeoning research in sleep science. This research has highlighted the deleterious effects of tiredness on a range of cognitive, emotional, and behavioral outcomes. One notable application of sleep science findings to a public health concern, which has had great success in recent decades, has been that of raising awareness of the impairing effects of tiredness while driving (Fletcher, McCulloch, Baulk, & Dawson, 2005). However, tiredness has not been adequately considered in the risk-taking literature on alcohol use and sexual behavior, despite the extensive work reviewed below which explores how tiredness impairs cognition, emotion, decision-making, and behavior.

**The Effects of Tiredness on Cognition, Emotion, and Decision-Making**

Whether caused by extended hours of being awake or by compromised sleep quality due to insomnia, interrupted sleep, or total sleep deprivation, the deleterious effects of tiredness have been shown on a range of cognitive outcomes. As indicated by numerous reviews (Durmer &
Dinges, 2005; Lim & Dinges, 2010; van der Helm & Walker, 2012), these impairments on cognition include: reduced attention and persistence, slowed response times, impaired working memory and short-term memory, and deteriorated performance on tasks requiring divergent thinking, cognitive flexibility, and multitasking. These impairing effects have been documented both in tightly-controlled lab settings and in an ever-expanding range of real-world performance-related domains such as: driving (e.g., Maia, Grandner, Findley, & Gurubhagavatula, 2013); military settings (Browne, Van Susteren, Onsager, Simpson, Salaymeh, & Condon, 1994; Hardaway & Gregory, 2005); medical settings (Rogers, Scott, Hwang, & Dinges, 2004), and perhaps most concerning, nuclear power plant work (Baker, Olson, & Morisseau, 1994).

Notably, some of these sleep-related impairments are observed after being awake for only 14 hours (impaired monitoring and awareness; Zhou et al., 2012), 15 hours (reduced working memory; Smith et al., 2002), 17 hours (impaired psychomotor vigilance; Dawson & Reid, 1997; Williamson & Feyer, 2000), and 24 hours (impaired postural sway; Schlesinger, Redfern, Dahl, & Jennings, 1998). Accordingly, tiredness has also been implicated in findings that police officers working shifts of 13.3 hours’ duration reported decreased concentration, cognitive processing, and quality of life, and greater anticipatory errors and complaints rates compared to officers working 10-hour shifts (Bell, Virden, Leis, & Cassify, 2015). Further, among more than 10,000 workers in the USA, working at least 12 hours a day was linked with a 37% increase in the odds of a workplace hazard (Dembe, Erickson, Delbos, & Banks, 2005). Even relatively mild sleep loss of only two hours a night has been shown to produce cognitive deficits equivalent to that observed for two-to-three standard drinks (Roehrs, Burduvali, Bonahoom, Drake, & Roth, 2003), or equivalent to a blood-alcohol concentration of 0.4-0.6% after four nights of five hours’ sleep per night (Elmenhorst et al., 2009). Crucially, we may not be accurate in gauging our levels
of tiredness and its numerous, potentially hazardous consequences (Womack, Hook, Reyna, & Ramos, 2013; Zhou et al., 2012).

In conjunction with this research on the effects of tiredness on cognition, chronobiology research has found that alertness oscillates throughout the day, or diurnally, according to circadian preference. On average, alertness has been shown to begin declining steadily after roughly 6pm at night (Åkerstedt, Folkard, & Portin, 2004). In addition, people report beginning to feel a sense of sleepiness after roughly 12 hours of being continuously awake (Sagaspe et al., 2006)—although there are patterned differences in alertness according to chronotype, where morning types (a.k.a., “early birds” or “morning larks”) report peak alertness earlier in the day but begin to fatigue sooner at night, while evening types (a.k.a., “night owls”) report peak alertness later, thus fatiguing later at night and/or the following morning (Kerkhof, 1998). Taken together, these findings of impairments beginning after roughly 14 hours of being awake and of people beginning to feel tired after 12 hours of being awake suggest that, if the average weekday waking time is around 7am (Walch, Cochran, & Forger, 2016), then from roughly 7-9pm onwards, many people will begin to experience increasing tiredness and impaired cognitive functioning. This could be expected to occur even sooner for morning types who are more likely to fatigue earlier, and particularly so for people who have accrued a cumulative sleep debt from consecutive nights of insufficient sleep (Dinges et al., 1997).

Tiredness has also been shown to adversely affect emotions (Kahn, Sheppes, & Sadeh, 2013; Perogamvros & Schwartz, 2015, for reviews), resulting in reduced positive affect (Bouwmans, Bos, Hoenders, Oldehinkel, & de Jonge, 2017; Finan, Quartana, & Smith, 2015; Ong, Bastarache, & Steptoe, 2015, for a review), and increased negative affect (Blaxton, Bergeman, Whitehead, Braun, & Payne, 2015; Bouwmans et al., 2017), confusion (Dinges et al.,
1997), depression (Babson, Trainor, Feldner, & Blumenthal, 2010), impulsivity and heightened reactivity to negative stimuli (Anderson & Platten, 2011), and frustration in ambiguous hypothetical social interactions (Kahn-Greene, Lipizzi, Conrad, Kamimori, & Killgore, 2006). At the same time as feeling worse, tiredness also impairs the individual’s ability to regulate or manage their emotions (Fairholme & Manber, 2015; Grillon, Quispe-Escudero, Mathur, & Ernst, 2015; Gruber & Cassoff, 2014; Mauss, Troy, & LeBourgeois, 2013; Palmer & Alfano, 2017) via its associations with: reduced inhibitory and attentional control (Garcia, Ramirez, Martinez, & Valdez, 2012; Sagaspe et al., 2006); compromised understanding of the emotions of others and of oneself (Daniela, Alessandro, Giuseppe, Fabio, & Cristina, 2010; Killgore et al., 2008); and the impaired ability to recognize facial emotions (Gujar, McDonald, Nishida, & Walker, 2011; Pallesen et al., 2004), to detect sarcasm (Deliens et al., 2015), and to appreciate humor (Killgore, McBride, Killgore, & Balkin, 2006). Tiredness has also been shown to increase the tendency to catastrophize (Talbot, McGlinchey, Kaplan, Dahl, & Harvey, 2010). In sum, the evidence indicates that an individual’s emotional state and ability to enact emotion regulation both worsen the longer they have been awake and the more overdue they are for sleep.

Given the above effects on cognition and emotion, tiredness also wields influence on decision-making and behaviors involving risk-taking—indeed, 18 of the 23 studies in a review by Womack et al. (2013) showed that sleep deprivation increased risk-taking. Tiredness has been linked to increased risk-taking when considering a gain and decreased risk-taking when considering a loss (McKenna, Dickinson, Orff, & Drummond, 2007), greater delay-discounting (Reynolds & Schiffbauer, 2004), and the increased tendency to select the easier, less demanding task in complex situations (Engle-Friedman et al., 2003). Each of these findings has direct implications for the individual when making a choice between an easy and immediate pleasure
(e.g., condomless sex) and a more complex, delayed alternative (e.g., negotiating sexual safety practices or attempting to resist having sex in-the-moment). Relatedly, lab-controlled sleep deprivation has been shown to influence behaviors involving self-regulation, increasing subsequent cigarette smoking (Hamidovic & de Wit, 2009), food intake (Brondel, Romer, Nougues, Touyarou, & Davenne, 2010), and snacking (Heath et al., 2012). Daily diary research has also shown that poor sleep quality predicted diminished self-regulatory resources the following night (Diestel, Rivkin, & Schmidt, 2015) and increased procrastination at work the following day (Kühnel, Bledow, & Feuerhahn, 2016), as well as lower cheerfulness, alertness, and overall well-being (Totterdell, Reynolds, Parkinson, & Briner, 1994). Conversely, maintaining sufficient and consistent sleep throughout weeknights has been shown to improve self-regulatory performance and to decrease psychological strain by the end of the week (Barber & Munz, 2011). Additionally, gaining a period of brief sleep has been shown to “reset” or remedy the detrimental effects of stress on depleted self-regulation (Park, Wright, Pais, & Ray, 2016), further highlighting the importance of sleep and the dangers of its lack.

The above effects of tiredness on cognition, emotion, and decision-making have compelled several researchers to develop models of health-related self-regulation in which poor sleep represents a risk factor for unhealthy decision-making (Barber, 2014; Hagger, 2014; Millar, 2017). The first two of these three papers focused on implications for health behaviors such as dieting, exercising, alcohol use, smoking, and coping with stress, whereas the third applied these considerations of tiredness to difficulties with self-regulating in relation to sexual behavior, as well as eating, smoking, and alcohol use. Terre (2014) also connected poor sleep to health behaviors such as smoking, unhealthy eating, and physical inactivity, but did not draw links to alcohol use or sexual behavior. Given that tiredness generally increases towards the end of the
waking day (Manly, Lewis, Robertson, Watson, & Datta, 2002), generally peaking just before bed-time (Watson, Wiese, Vaidya, & Tellegen, 1999), it was argued by Millar (2017) that it is important to consider its effects on health behaviors which also commonly occur around this time, such as alcohol use and sex.

In sum, this section has presented evidence that tiredness (in the absence of restoratives such as naps or the use of compensatory stimulants such as caffeine) can generally be viewed as a factor that systematically impairs self-regulation, and that its effects become more pronounced the longer that an individual has gone without sleep. However, as will be shown in the following sections reviewing the limited literature on sleep in relation to alcohol use and sexual behavior, further research is needed to explore links between tiredness and the two behaviors.

**Review of Literature on Tiredness and Alcohol Use**

While tiredness has been shown, in sleep science literature as reviewed above, to impair decision-making in a wide range of behaviors and tasks, it has only received scant attention in research on decision-making regarding alcohol use. Literature searches for studies on “alcohol” and “sleep” or “fatigue” yield results that are dominated by studies looking at alcohol’s effects on subsequent sleep quality and on sleep problems arising from alcoholism (e.g., Brower, Aldrich, & Hall, 1998; Angarita, Emadi, Hodges, & Morgan, 2016, for reviews). Also, some studies have looked at the use of alcohol to help people get to sleep (Brower, Aldrich, Robinson, Zucker, & Greden, 2001; Stein & Friedmann, 2006). However, research has rarely considered the effect of poor sleep quality and resulting tiredness on decision-making regarding alcohol use.

Where research has considered this issue, it has thus far largely focused on alcohol use behaviors among adolescents and not adults. Cross-sectional links between poor sleep and alcohol use have been identified in various samples of adolescents (Hasler, Soehner, & Clark,
2014, 2015; Meldrum, Barnes, & Hay, 2015; Popovici & French, 2013), including studies of larger population datasets (McKnight-Eily et al., 2011; Sivertsen, Skogen, Jakobsen, & Hysing, 2015; Winsler, Deutsch, Vorona, Payne, & Szklo-Coxe, 2015). Some studies have also considered the event-level association between poor sleep and subsequent behavioral dysregulation in adolescents, including subsequent substance use (Kouros & El-Sheikh, 2015; Spruyt, Alaribe, & Nwabara, 2016). This focus on adolescents is warranted given that adolescence is a time period when both sleep health (e.g., changing circadian rhythms and conflicting factors such as early start-times for school) and alcohol use behaviors are undergoing critical changes (Hasler et al., 2015). Compellingly, Edwards, Reeves, and Fishbein (2015) proposed an integrative model that placed emotion dysregulation as the mediator between sleep problems and substance use in adolescents—but this relationship has rarely been applied to alcohol use behaviors among adults (Hasler, Smith, Cousins, & Bootzin, 2012).

Despite mention made over 15 years ago of the possible bidirectional relationship between tiredness and drinking (Roehrs & Roth, 2001), the situational influence of tiredness on alcohol use decisions and behaviors among adults has remained largely unexplored. The few exceptions include: a recent study on how daily sleep quality influences subsequent craving for alcohol and drugs via its impact on reduced positive affect (Lydon-Staley et al., 2016); a study of Canadian adults which found that shorter-than-average sleep duration was associated with greater alcohol use (Chaput, McNeil, Després, Bouchard, & Tremblay, 2012); a study of 219 university students among whom poorer overall sleep quality was associated with stronger motives of drinking to cope (Digdon & Landry, 2013); and a study of heavy-drinking college students which tested a model where poorer overall sleep quality partially mediated the association between poor mental health and drinking (Kenney et al., 2013). Though many daily
diary studies on factors predicting alcohol use in adults have been conducted, they have neglected to look at tiredness or have not linked the time of day when drinking first occurred to the issue of tiredness (e.g., Cohn, Brandon, Armeli, Ehlke, & Bowers, 2015; Ehrenberg, Armeli, Howland, & Tennen, 2016; Kuerbis, Armeli, Muench, & Morgenstern, 2013; Littlefield, Talley, & Jackson, 2012; O'Hara, Armeli, & Tennen, 2014; Rendina, Ventuneac, Mustanski, Grov, & Parsons, 2016; Weiss, Bold, Sullivan, Armeli, & Tennen, 2017). Indeed, in a recent meta-analysis on cravings and substance use (Serre, Fatseas, Swendsen, & Auriacombe, 2015), only two of 91 studies mentioned fatigue as a correlate, while none looked at time of day.

Encouragingly, there have been two recent studies that have looked at global sleep quality among GBM—one in which drug use was associated with poorer sleep quality among HIV-positive GBM (Downing et al., 2016), and another in which poor sleep health was associated with increased substance use among men who have sex with men (as well as sexual risk-taking which will be explored in the next section; Duncan et al., 2016). However, further research on sleep, tiredness, and alcohol use among adults is needed.

This comparative lack of attention to tiredness and alcohol use among adults is rather surprising, given that numerous studies have made mention of higher rates of drinking at night (Arfken 1988; Armeli, DeHart, Tennen, Todd, & Affleck, 2007; Dawson, 1996; de Castro, 2004; Room et al., 2012; Todd, Armeli, & Tennen, 2009), and particularly on Friday and Saturday nights (Carney, Armeli, Tennen, Affleck, & O’Neil, 2000; Kuntsche, Otten, & Labhart, 2015). Indeed, Shiffman’s (2009) review article on daily diary studies noted that drinking tends to be concentrated on particular days (e.g., Fridays and Saturdays) and times of day (e.g., nighttime). Also, alcohol cravings have been found to occur most often at night (Piasecki et al., 2011). Further evidence that alcohol use often happens late at night was suggested by a study of the
feasibility and acceptability of a mobile-tracking app for Black men who have sex with men to record their drinking episodes (Yang et al., 2015). In qualitative feedback, participants suggested that the researchers should extend the hours of data collection later at night to better capture times when people are more likely to be out drinking. One participant suggested that researchers should “increase the [reporting] time on weekends to around 1 or 2 [am]. That’s when the clubs close and if you do that, you would get some good data” (p.7). Given that tiredness tends to peak later at night, its coinciding with alcohol use late at night warrants further investigation, and will be addressed in subsequent sections of this dissertation.

Review of Literature on Tiredness and Sexual Risk-Taking

Tiredness has been even more neglected in relation to sexual behavior both among the general population and GBM. Notable exceptions include: the previously-mentioned survey study by Duncan and colleagues (2016) which found that poor sleep quality as a person-level characteristic was associated with higher rates of receptive CAS among GBM; two experimental studies which found that sleep deprivation in men led them to pay greater attention to images of attractive females (Zarcone, de la Pena, & Dement, 1974) and to overestimate a woman’s level of interest and intent regarding sex (Pezska et al., 2013); a study in which women with poorer overall sleep quality reported greater sexual arousal after an induced sexual fantasy exercise (Costa & Oliveira, 2016); a survey study of young adults which found that shorter sleep duration was associated with less restricted views on sociosexual attitudes and desire, as was having an evening chronotype which itself was also associated with shorter sleep duration (Randler, Jankowski, Rahafar, & Diaz-Morales, 2016); and a survey study on mostly heterosexual adolescents which connected poor sleep health to a range of risk-taking behaviors including sex (McKnight-Eily et al., 2011). Taken together, these studies suggest that a lack of sleep or poorer
sleep quality can increase sexual arousal and activity, and/or reduce the ability to self-regulate or inhibit sexual arousal and activity when presented with sexually-arousing stimuli.

The only other studies looking at sleep and sex, of which I am aware, have focused on heterosexual samples and have instead identified links between poor sleep and reduced sexual functioning. This pattern has been observed in older adults in general (Allen & Desille, 2017), in younger females (Kalmbach, Arnedt, Pillai, & Ciesla, 2015), in older, post-menopausal women (Kling et al., 2017), and in men with sleep apnea (Budweiser et al., 2009; Chen et al., 2016) or insomnia (Lin et al., 2015). Separately, work has looked at sleep disorders and abnormal sexual behavior (Schenck, Arnulf, & Mahowald, 2007). To my knowledge, the day- or event-level effects of poor sleep quality and sexual behavior have not been investigated amongst either heterosexual or sexual minority samples, whether in adolescence or adulthood.

Somewhat tangentially, research does exist showing that, similar to alcohol use, sex is a behavior that frequently occurs at night when tiredness could be a factor in decision-making and self-regulation. A small number of studies—all on mostly heterosexual samples—could be called on to support pop song declarations that sexual situations generally occur “in the heat of the night” or “in the midnight hour.” These studies include: a survey of young married couples in South Carolina which found that more than 60% of “copulations” occurred between 10pm and 1am, increasing on weekends with a secondary peak in the mornings (Palmer, Udry, & Morris, 1982); an Israeli study which found that first sexual experiences occurred in the evening or night for 87% of the 108 women surveyed (Barak, Stein, Ring, Ticher, & Elizur, 1997); a study surveying Californian heterosexual adults which found that sex most often occurred between 11pm and 1am, with a secondary peak occurring in the morning between 6-8am (Refinetti, 2005); and a Polish study which found that the usual time of sex peaked between 6pm and
midnight (Jankowski, Díaz-Morales, & Randler, 2014). Interestingly, this last study is the only one, to my knowledge, which also assessed the timing of desire for sex and found that it fluctuates across time—most commonly peaking between 6pm and midnight with a secondary peak reported between 6-9am. Further, the authors noted that, among their 126 male participants, those with an evening chronotype reported sexual desire peaking even later, between 9pm and 3am—and this issue of chronotype will be explored in sections below. In sum, these studies indicate that sex most commonly occurs at night, as does desire for sex, among mostly heterosexual samples.

The only study, to my knowledge, that has addressed the topic of sex and time of day among GBM is a recent paper on patterns of men’s usage of a popular mobile app for sex hook-ups (Goedel & Duncan, 2015), which found that most GBM reported being active on the site in the evening (34.8%) or late at night (40.2%), compared to early morning (6.5%), morning (8.7%), and afternoon (9.8%). In addition to heightened sexual desire at night (Jankowski et al., 2014), there may also be more opportunities for sex at night due to various practical reasons, as argued by Millar (2017), including the scheduling of sex around daytime work/school and/or home commitments, proximity to a bed or other sex-appropriate setting, the timing of social events for meeting prospective partners, and the increased accessibility of bars, clubs, and other venues at night. Additionally, social scripts regarding the appropriateness of sex at night (relative to sex during the day) may also be influential. In sum, it is argued that sex is largely, though by no means exclusively, a behavior that occurs at night, and often late at night just before people go to sleep—however, the role of tiredness in people’s sexual decision-making has not been sufficiently explored.
Framework for Considering Tiredness in Alcohol Use and Sexual Risk-Taking

Thus far in this dissertation, I have: (1) reviewed evidence of the well-established impairing effects of tiredness on cognition, emotion, and decision-making, and have noted the relatively small number of studies connecting global levels of sleep quality to increased risk-taking in alcohol use and sexual behavior; (2) presented evidence that both behaviors of interest—alcohol use and sex—can generally be considered, for the most past, as nighttime activities; (3) and argued that their status as nighttime activities is relevant because nighttime is when people commonly begin to feel the effects of tiredness (Watson et al., 1999), although patterned differences exist according to chronotype whereby morning types are expected to experience tiredness earlier in the night while evening types are expected to do so later at night.

As noted however, the existing research on tiredness and/or the timing of alcohol use and sex among GBM is very limited—and more research is warranted given the elevated rates of alcohol use and HIV infection rates among this population. In essence, I propose that tiredness is a fluctuating, within-person variable that should be considered as a risk factor in alcohol use and sexual behavior among GBM—and perhaps among other populations too, though this is not explored in the current dissertation.

Before presenting the conceptual model below, I now briefly describe alcohol research regarding alcohol’s stimulatory effects in order to suggest the possibility that tiredness may actually motive alcohol use. While alcohol’s effects are typically characterized as depressant in nature (e.g., drowsiness, slowed reactions, slurred speech), there is also evidence that alcohol’s initial, more immediate effects are stimulatory in nature (Hendler, Ramchandani, Gilman, & Hommer, 2013; Martin, Earleywine, Musty, Perrine, & Swift, 1993). Indeed, these two kinds of effects of alcohol are captured by the items in the Biphasic Alcohol Effects Scales (Martin et al.,
1993), which assesses seven subjective states associated with stimulatory effects (i.e., feeling elated, energized, excited, stimulated, talkative, up, and vigorous) that occur during the “ascending limb” and seven states that are associated with sedatory effects (i.e., difficulty concentrating, down, heavy head, inactive, sedated, slow thoughts, and sluggish) that occur during the “descending limb.” Hendler and colleagues (2013) provided evidence that as blood-alcohol content increases, the more immediate, stimulatory effects of alcohol are felt, such as increased heart rate, short-term energy, and increased dopamine release and/or blocking of receptors in the midbrain that typically inhibit dopamine. Later in the drinking event, after blood-alcohol levels peak, the better-known sedatory or depressant effects of alcohol become more pronounced. As further impetus for considering younger age as a risk factor, there is evidence that adolescents are less sensitive to the sedatory effects of alcohol (Spear, 2000) and that, among young adults, the stimulatory effects of alcohol are more pronounced when alcohol is consumed in the evening compared to earlier in the day (Van Reen, Rupp, Acebo, Seifer, & Carskadon, 2013).

These temporary stimulatory effects are further compounded in what Ferré and O’Brien (2011) refer to as ‘the perfect storm’: when alcoholic drinks are mixed with caffeine or energy drinks (Wells, Kelly, Pawson, LeClair, Parsons, & Golub, 2013; CDC, 2017; Snipes & Benotsch, 2013) or are accompanied by stimulant drugs. The possibility that the initial stimulatory effects of alcohol may actually motivate or promote drinking when the individual is feeling tired or fatigued is reflected in colloquial terms such as being in need of a “pick me up” or, to use a British term for an alcoholic drink, a “livener.” However, this has not been adequately explored in the alcohol literature, other than tangentially in research on drinking motivations which has included “enhancement” motives amongst the reasons why people drink (Cooper et al., 1992).
Accordingly, one focus of the current dissertation will be to explore whether the desire to combat tiredness and stay awake longer can, in fact, be a motivating factor that facilitates alcohol use. To my knowledge however, no research has yet considered whether tiredness could also be a motivating factor in sexual behavior.

The relative lack of consideration of tiredness as a factor in alcohol use and sexual risk-taking may have arisen because of the commonly-held assumption that being tired decreases activity—i.e., that being tired reduces the likelihood of engaging in effortful, active behaviors such as drinking alcohol or initiating and performing sex. Certainly, in states of severe fatigue, this suppression of activity would be understandable and can be formidable (Killgore, 2007), but is less applicable for more moderate levels of tiredness (Engle-Friedman, 2014, for a review). Therefore, while this suppressive effect of severe tiredness is represented by Pathway A in the conceptual model in Figure 1, it is not explicitly tested in the following analyses. Instead, I propose that, at more moderate levels of tiredness and working in opposition to this pathway, there are two other pathways by which tiredness may be operating to increase the likelihood of these behaviors, separately alcohol use and sexual risk-taking. These proposed pathways are represented by Pathways B and C in the conceptual model in Figure 1.

Pathway B depicts how tiredness impairs self-regulation—as has been well-established in the sleep science literature—thereby lessening one’s capacity to manage or refrain from engaging in the risk-taking behavior and thus raising the odds of engaging in the behavior. This pathway is, in part, an adaptation of Edwards and colleagues’ (2015) model for adolescent substance use in which poor sleep impacts emotion regulation, in applying it to adults’ alcohol use. In addition, however, Pathway C proposes that tiredness can also prompt or motivate the
individual to engage in the behavior either to combat tiredness (as in the case of alcohol use) or because they feel stronger desire for the behavior (as in the case of sexual behavior).

Although the current dissertation mostly focuses on Pathway C—that being tired can actually motivate GBM to engage in the respective behaviors—it does not comprehensively test all three pathways in this model simultaneously. However, it does seek to investigate aspects of Pathways A and B in a number of ways. Analyses will seek to provide evidence that Pathway A alone is not sufficient in the explanation of these behaviors because, for many people (here, GBM specifically), tiredness does not necessarily or reliably lower the odds of engaging in alcohol use or sex. It will be shown that both behaviors commonly or frequently occur in the context of tiredness and that, therefore, Pathway A does not apply uniformly to all GBM.

Further, in addition to what has already been reviewed in the sleep science literature regarding the impairing effects of tiredness on self-regulation, analyses will also seek to partially address Pathway B—that tiredness increases the level of risk involved in the two behaviors of drinking alcohol and having sex.

Currently, very little information exists on when GBM engage in alcohol use and sexual behavior and whether these times vary according to age or chronotype. If these behaviors are found to commonly occur at night, and as tiredness is typically more strongly felt at night (Watson et al., 1999), then it is argued that a closer consideration of tiredness as a factor in risk-taking regarding alcohol use and sex is warranted, both for its known impairing effects on decision-making and for the previously unexplored possibility that tiredness may actually motivate both alcohol use and sexual activity. Tiredness has only been partially recognized as a motivator of alcohol use (e.g., with enhancement as a drinking motive; Cooper et al., 1992), but not in its own right—although, energy drink research partially approaches this issue (MacKillop
et al., 2012; Miller, Dermen, & Lucke, 2017), as does Hendler and colleagues’ (2013) work on the stimulatory effects of alcohol. Even less is known about how tiredness interacts with sexual desire and sexual behavior. In sum, more research is needed on these possible connections, and is therefore undertaken within this dissertation according to the following aims.

**Aims and Hypotheses**

As outlined below, Aims 1-3 relate to alcohol use, testing Hypotheses 1-5, and Aims 4-6 relate to sexual behavior and sexual behavior, testing Hypotheses 6-11.

**Aim 1:** The first aim was to provide evidence for the time of day when alcohol use most commonly occurs among GBM. This tests the following two hypotheses.

Hypothesis 1: that the majority of GBM surveyed will report that their most frequent time of drinking is at night (either during the evening between 5pm and 9pm, or later at night from 9pm onwards), compared to other times of day.

Hypothesis 2: that younger GBM are more likely to report peak drinking later at night (i.e., 9pm onwards compared to earlier times) than older GBM, as are those reporting an evening chronotype compared to earlier chronotypes.

**Aim 2:** The second aim was to show that tiredness can motivate alcohol use among GBM.

Hypothesis 3: that the majority of GBM will report that the experience of feeling tired can motivate their use of alcohol (whether with or without energy drinks) in order to help them combat tiredness.

**Aim 3:** The third aim was to utilize multilevel modeling of event-level data to ascertain whether worse-than-usual sleep quality predicts alcohol use the following day.

Hypothesis 4: that previous night’s sleep quality will be associated with greater odds of subsequent alcohol use (vs. no use) on a given day.
Hypothesis 5: that previous night’s sleep quality will be associated with greater odds of heavy drinking (vs. drinking only 1-4 drinks) on a given day.

**Aim 4:** The fourth aim was to provide evidence for the time of day when sex (both sex with condoms and sex without condoms) most commonly occurs for GBM, utilizing data from the same dataset as in Aim 2.

Hypothesis 6: that the majority of GBM surveyed will report that their most recent event of anal sex (without and with condoms) with a casual male partner occurred during the evening and night, compared to day-time.

Hypothesis 7: that the odds of sex having occurred from 9pm onwards will be greater among younger men and among evening types.

**Aim 5:** The fifth aim was to provide evidence that tiredness does not necessarily dampen or reduce sexual desire and can actually increase sexual desire, and that it may also increase one’s odds of being the receptive partner in anal sex. This will utilize data from the same study as in Aims 2 and 4.

Hypothesis 8: that tiredness does not uniformly reduce the possibility of sexual desire. In other words, when tired, GBM may still be likely to feel sexual desire or may feel increased sexual desire.

Hypothesis 9: that GBM will report that being tired can increase their odds of being the receptive partner in anal sex.

**Aim 6:** Finally, the sixth aim was to utilize multilevel modeling of event-level data to ascertain whether worse-than-usual sleep quality predicts sexual behavior the following day, utilizing data from the same daily diary study as in Aim 3.
Hypothesis 10: that previous night’s sleep quality will not be associated with the odds of subsequent sexual engagement (i.e., having any sexual activity with a partner vs. none).

Hypothesis 11: that previous night’s sleep quality will be associated with increased odds of engagement in CAS (i.e., having CAS vs. non-CAS sexual activity) on a given day when sexual activity occurs.
CHAPTER TWO

Aim 1: Time of Day When Alcohol Use Most Commonly Occurs

In order to gather data on when alcohol use most commonly occurs among GBM and whether this varies by age or chronotype, two questions were included in a CDC-funded online study surveying GBM across the USA. As stated in the Introduction, the goal of Aim 1 was to test the following two hypotheses: that the majority of GBM surveyed will report that they most frequently use alcohol at night—categorized as either evening time (5-9pm) or later at night (9pm onwards)—compared to daytime (Hypothesis 1), and that the reporting of the later time of peak drinking (i.e., 9pm onwards vs. day/evening time) will be more common among younger GBM and among those reporting an evening chronotype (Hypothesis 2).

Method

Participants

The data were drawn from Health Online, a study of GBM recruited from a variety of sources: online sexually-focused websites and apps; a general social networking site (Facebook); in-person at various New York based clinics and field sites; and a national sample of GBM enrolled in a longitudinal study (i.e., the One Thousand Strong cohort). However, of the 7,897 Health Online participants, the questions specific to this aim were only asked of the 3,696 GBM recruited from the four online sources: a hook-up website \((n = 909, 24.6\%)\), a hook-up app \((n = 1,885, 51.0\%)\), porn sites \((n = 448, 12.1\%)\), and Facebook \((n = 454, 12.3\%)\). Demographic details on these 3,696 GBM are displayed in Table 1.

Procedure

Upon giving their consent to participate and receiving their link to the online computer-assisted survey instrument (CASI), participants in Health Online completed the measures online.
through a Qualtrics-hosted survey. Participants were not directly compensated for completion of the survey, as they were being screened for a paid study if they were eligible—however, they were entered to win a raffle. Within each recruitment source, a $20 Amazon gift card was drawn for every 50 participants. All procedures were approved by the City University of New York Institutional Review Board.

**Measures**

**Demographics.** Participants were asked a range of demographic questions regarding age, race and ethnicity, sexual orientation, HIV-status, education level, and relationship status.

**Timing of peak alcohol use.** Participants were asked to respond to the following question regarding the timing of when they have most often consumed alcohol in recent months: “We are interested in the time of day or night when people are most likely to use alcohol [or drugs]. During the last 3 months, when have you most often consumed alcohol?” The response options included: 1 (*mostly in the morning after waking up*), 2 (*mostly in the afternoon*), 3 (*mostly in the evening, 5pm to 9pm*), 4 (*mostly later at night, 9pm or later*), or 5 (*not applicable to me—I haven’t consumed alcohol in the last 3 months*).

**Chronotype.** Participants also rated their chronotype preference on a single item taken from the widely-used Horne and Östberg Morningness-Eveningness Questionnaire (MEQ; Horne & Östberg, 1975). The original 19-item scale was shortened by Adan and Almirall (MEQ-R; 1991) to a five-item scale, in which the single item used here displayed the strongest psychometric properties of the five items, having the highest correlation with the total score of the overall shortened scale ($r = 0.89$; Adan & Almirall, 1991). This finding was replicated by Chelminski, Petros, Plaud, and Ferraro (2000), showing that the item’s correlation with the five-item shortened scale total was $r = 0.88$. It has thus been used elsewhere as a sole-item indicator.
of chronotype in other studies (Hersh, Sisti, Richiutti, & Schernhammer, 2015; Loureiro & Garcia-Marques, 2015; Randler, Faßl, & Kalb, 2017; Turco et al., 2015). The item reads:

Many people describe themselves as a “morning person” (aka. “morning type” or “an early bird”), while many others describe themselves as an “evening person” (aka. “night person” or “a night owl”). Which do you consider yourself to be?

The response options from the original scale range from 1 (definitely a "morning person"), 2 (rather more of a "morning person" than an "evening person"), 3 (rather more of an "evening person" than a "morning person"), to 4 (definitely an "evening person"). In the current study, an additional response option was inserted, 5 (neither one - my levels of alertness and energy do not really change throughout the day), as has been done in a previous study which used the response 5 (neither) (Ramin et al., 2013). When used in the original scale, the item is scored by assigning a value of 6, 4, 2, or 0 to the four original response options, which then contributes to a continuous score where higher scores indicate stronger morningness and lower scores indicate stronger eveningness. However, the current analyses operationalized a nominal variable indicating three groups: morning types, neither types, and evening types. Here, the response options of 1 and 2 were combined to indicate having a morning chronotype (recoded as a 0), and options 3 and 4 were combined to indicate having an evening chronotype (recoded as a 2), while option 5 was coded as indicating having neither a morning or evening chronotype (recoded as a 1), in line with Ramin and colleagues (2013).

Analytic Plan

As with all analyses in this dissertation, these analyses were conducted using SPSS Version 24. Bivariate comparisons on demographic factors (χ² tests of independence for categorical variables and an independent samples t–test for age as a continuous variable)
between those included in the analytic sample for subsequent analyses (i.e., those reporting recent drinking) and those reporting no recent drinking) were conducted. Those men reporting no recent drinking in the past three months were excluded from subsequent analyses. Results of follow-up tests are indicated, when significant, by superscripts.

Bivariate comparisons between those reporting they most frequently use alcohol in the day or evening (combined) vs. later at night (9pm onwards) by the primary variables—age and chronotype—were conducted. An independent samples t-test was conducted to compare age differences according to these drinking times, and χ² tests of independence were conducted to explore differences between the three chronotype groupings (morning types, neither type, and evening type), as well as for a range of other demographic groupings for which hypotheses were not advanced: HIV status (HIV-negative or unknown vs. HIV-positive), recruitment source, race and ethnicity, and relationship status. Where omnibus χ² tests of significance indicated, follow-up tests of between-group differences were conducted, as indicated by superscripts.

In a multivariable context, binary logistic regression analyses were conducted to predict the odds of the later drinking time (9pm onwards, compared to day/evening). In a step-wise process, age was entered alongside other demographic variables (race and ethnicity, with White GBM as the referent category; recruitment source, with hook-up website and porn sites as the referent category; and relationship status, with partnered men as the referent category), were entered in the first step of the model. In the second step of the model, chronotype (with morning types as the referent category) was entered. Improvement in model fit with the addition of chronotype in the second step was indicated by Model- and Step-χ² statistics and inspection of fit statistics, the percentage correctly classified and the Hosmer and Lemeshow χ² (where a
statistically significant result indicates that the covariance matrix implied by the specified model deviates significantly from that observed in the data).

Results

As displayed in Table 1, of the 3,696 participants in Project Health Online drawn from online sources, most were White (62.6%), gay (81.9%), single (63.4%), and of a negative or unknown HIV status (82.3%). The average age of the full sample was 38.9 years, ranging from 18 to 85 years, and 84.7% reported having at least some college-level education. In terms of chronotype, most participants reported being an evening type (53.5%), followed by 29.8% reporting being a morning type, while 16.7% reported being neither a morning or evening type (referred to as “Neither Type”). As depicted in Figure 2, the question of time of most frequent drinking was not applicable to 882 men (23.9%), as they reported having not consumed any alcohol in the past three months. Comparisons in Table 1 show that the 2,814 men (76.1%) reporting recent alcohol use were, on average, younger than those excluded for being non-drinkers, and included a greater proportion of men with a main partner, a negative or unknown HIV status, higher education levels, and an evening chronotype, and having been recruited from the hook-up app.

Of the 2,814 men who did report recent alcohol use and thus constituted the analytic sample, the vast majority (97.5%) reported that their time of most frequent drinking was at night—1,301 (46.2%) in the evening between 5pm and 9pm, and 1,444 (51.3%) later at night from 9pm onwards. Only 69 (2.5%) of these men reported most frequently drinking during the day. Bivariate comparisons among the 2,814 men, as displayed in Table 2, showed that their drinking times differed according to age and chronotype. Those reporting a later time of most frequent drinking (9pm onwards) were, on average, younger (\( M = 33.8 \) years, \( SD = 11.6 \)) than
those reporting most frequent drinking during the day/evening \((M = 41.9, SD = 13.8)\). Among morning types, 66.8% reported most frequent drinking in the day/evening, while only 33.2% reported most frequent drinking at night after 9pm. However, this pattern was reversed among evening types of whom only 39.6% reported most frequent drinking in the day/evening, while 60.4% reported most frequent drinking at night after 9pm. Predictably, in between the two groups of morning types and evening types, those reporting neither chronotype were more equally divided between drinking in the day and evening (49.1%) and at night after 9pm (50.9%). These chronotype distributions are depicted in Figure 3.

Additional checks of variables for which hypotheses were not advanced showed that these participants’ times of most frequent drinking also differed by relationship status (a greater proportion of single men reported the later-than-9pm drinking time than did partnered men), race and ethnicity (a greater proportion of GBM of color reported the later-than-9pm drinking time than did White GBM), and recruitment source (a greater proportion of men recruited from the hook-up app and Facebook reported the later-than-9pm drinking time, compared to those recruited from the hook-up website and porn sites). However, it should be noted that each of these covariates which were associated with drinking time was also significantly correlated with age. In each case, younger age was significantly associated with the group endorsing the later-than-9pm time of drinking—in other words, single men were, on average, younger than partnered men; men of color were, on average, younger than White men; and participants recruited from the hookup app and from Facebook were, on average, younger than those from the hookup site and porn sites.

Significant age differences were also observed according to chronotype. Those with an evening chronotype were significantly younger \((M = 36.5, SD = 12.7)\) than morning types \((M = \)
43.3, SD = 14.0) and neither types (M = 38.8, SD = 14.2), F (2, 3693) = 92.07, p < 0.001. Binary logistic regression analyses displayed in Table 3 showed that reporting the later-than-9pm drinking time was associated with both younger age and a later chronotype as concurrent predictors, as hypothesized. Indeed, men with evening chronotypes were more than 2.5 times more likely to report the later-than-9pm time for peak drinking compared to men with morning chronotypes, and men with neither chronotype were 1.7 times more likely to do so compared to men with morning chronotypes. Age and chronotype were both significantly associated with reporting the later-than-9pm drinking time, adjusting for covariates: race and ethnicity (where GBM of color were found to be more likely to report the later-than-9pm time than White GBM), recruitment source (where men recruited from the hookup app and Facebook were also found to be more likely to report the later-than-9pm time than men recruited from the hookup site and porn sites), and relationship status (where single men were more likely to report the later-than-9pm time than partnered men). The addition of chronotype in the second step significantly improved model fit and increased the percentage of those correctly classified by the model.

Discussion

These results provide evidence that, among alcohol-using GBM recruited into an online survey study, drinking most frequently occurs later in the day—most commonly later at night (from 9pm onwards), followed by evening (between 5pm and 9pm). Accordingly, this support of Hypothesis 1 indicates that alcohol use can be considered as primarily a nighttime activity for the vast majority of these men. Indeed, only a very small percentage (2.5%) reported time of most frequent drinking during the day, while the vast majority (97.5%) reported either late-night or evening drinking times. These findings add to what has been previously learned about the contexts in which people drink alcohol. Previous research has uncovered that people tend to
drink more alcohol on weekends, with friends, and in bars (Armeli et al., 2007; Carney et al., 2000; Freisthler et al., 2014; Kuntsche et al., 2015; Todd et al., 2009). The current findings add to this by providing evidence about when GBM most often drink—here, that the majority of the GBM we surveyed drink most often at night. This concurs with studies that have also observed increased drinking at night among the general population (Arfken, 1988; Dawson, 1996; Room et al., 2012; Shiffman, 2009).

Results also supported Hypothesis 2, showing that both younger age and a later chronotype were positively associated with the increased odds of reporting the later-than-9pm drinking time. This may be due to lifestyle factors among younger men such as employment (e.g., working later shifts) or timing preferences for social activities and norms amongst friends, and concurs with Dawson’s (1996) study analyzing population data collected in 1992, which also showed that later times of drinking were more commonly reported by younger adults. Even when adjusting for age, chronotype remained informative—compared to morning types, those with an evening or neither chronotype were more likely to report the later-than-9pm drinking time. This chronotype finding is consistent with chronobiology research showing greater rates of general activity and socializing at night, and later wake-times amongst those with later chronotypes (Horne & Östberg, 1977; Roenneberg, Wirz-Jus subsete, & Merrow, 2003). It is also noteworthy that having an evening chronotype was itself positively associated with reporting recent alcohol use (vs. not having used alcohol in the past three months), and this accords with previous research that an evening chronotype is associated with greater substance use in general populations (Adan, 1994; Digdon & Landry, 2013; Hasler et al., 2014, 2015; Prat & Adan, 2011; Wittman, Paulus, & Roenneberg, 2010).
It should be noted that, in the *Online Health* sample, those with an evening chronotype were significantly younger than morning types and neither types. This is consistent with chronobiology research showing that younger men tend to have a later chronotype than older men (Duarte et al., 2014; Randler, 2016; Roenneberg et al., 2007). However, our multivariable analyses showed that the influence of chronotype persisted even when adjusting for age, as well as other relevant variables such as race and ethnicity, recruitment source, and relationship status.

Furthermore, it is interesting to note that not all morning types reported the earlier evening time for drinking. Indeed, a substantial proportion of morning types (33.2%) reported drinking times later at night after 9pm, by which time it can be expected that the typical morning person would be feeling tired or at least not in their prime, but instead in their circadian off-time (Wittmann, Dinich, Merrow, & Roenneberg, 2006). This has implications for their level of alertness when their alcohol use decisions are being made—in other words, it can be argued that the individual may not be at their optimal level of alertness when deciding about whether to drink and how to manage their rate of drinking. This point could also be applied, though less strongly, to those with neither chronotype (of whom 50.9% reported the later time of drinking) as they are also expected to be experiencing tiredness later at night.

A limitation of the *Online Health* study is the brevity of the measures used. Greater precision regarding the exact times of most frequent drinking would be informative, as the current study was unable to determine exactly how late this drinking may be occurring amongst those who endorsed each option. Drinking after midnight, for example, may have stronger implications for the potential role of tiredness in decision-making and behavior, even for those with an evening chronotype, as sleep-related impairments are expected to have emerged for all chronotypes by this time of night. It should be noted that *Online Health* only asked about time of
most frequent drinking and not about concurrent levels of tiredness when drinking. It would also be interesting to uncover which days of the week involve most frequent drinking, and whether later drinking times also involve the use of stimulant drugs if people are beginning to feel tired. More detailed information on lifestyle factors for these men would be relevant, such as whether they are shift-workers, as perhaps many of the 69 men reporting drinking most often during the day may be living on nocturnal schedules. Other measures of problematic drinking or alcohol abuse could be informative, as perhaps a greater proportion of those reporting drinking most often during the day may be chronic drinkers for whom the time of day may matter less. A more comprehensive measure of chronotype would also be advantageous in future research, as well as explorations of other factors such as whether peak drinking occurs in social contexts versus drinking alone.

Future research could also explore some of the other demographic differences noted in additional analyses here—that the later drinking time was more commonly reported by single men, men of color, and those recruited from the hookup app and Facebook—and also that various factors were associated with increased odds of reporting any alcohol use vs. non-use (e.g., being HIV-negative, partnered, more highly educated, recruited from the hookup app, and younger, and having an evening chronotype). Comparisons between men living in urban, metropolitan cities (vs. rural areas, which was not asked in the current survey) might also be important. Future research on drug use could explore how times vary according to specific drug types and whether this occurs in combination with alcohol use.

Despite these limitations, the current findings substantiate what many people might consider a relatively commonsense point—that drinking alcohol is primarily a nighttime activity, more commonly occurring later for younger men and for those with a later chronotype. Perhaps
less expected is the finding that a substantial number of morning types reported the later drinking time of 9pm onwards, presumably when their alertness, energy, and ability to self-regulate are expected to be impaired. The current study asked only about the time of drinking, but did not ask about the individual’s motives for using alcohol—it may be that some of these individuals are using alcohol at a later time of night in order to help them stay awake while others may be doing so to help them fall asleep. Further research is needed to examine whether the lateness of the hour when drinking most often occurs might be inadvertently introducing factors such as tiredness or fatigue into the decisions that GBM are making about whether to have another drink, or whether to engage in other health-compromising behaviors such as drug use, sexual risk-taking, or driving while intoxicated.
CHAPTER THREE

Aim 2: Tiredness as a Motivator of Alcohol Use

In order to test whether tiredness motivates alcohol use, a number of questions were devised by the author and included in the One Thousand Strong study. As stated in the Introduction, the goal of this aim was to test Hypothesis 3: that GBM will report that feeling tired sometimes motivates their use of alcohol in order to help them stay awake. This will be tested both in relation to drinking alcohol and drinking alcohol mixed with energy drinks. Follow-up tests will check whether this use of alcohol to stay awake longer varies according to age or chronotype.

Method

Participants

Data were drawn from the 24-month assessment of the One Thousand Strong study, a longitudinal study following a national cohort of HIV-negative GBM over a period of three years (Grov et al., 2016). Participants had been identified via Community Marketing and Insight’s (CMI) panel of over 22,000 GBM throughout the USA, and were deemed eligible if they: were at least 18 years of age; were biologically male and currently identified as male and as gay or bisexual; self-reported an HIV-negative status, and; were able to complete online surveys in English and at-home self-administered testing for HIV (oral) and STIs. To have been eligible, participants also needed to report having sex with a man within the previous five years, have an address to receive mail that was not a P.O. Box, and have not moved more than twice in the past six months prior (i.e., residential stability). Of the 1,071 men who joined the study at baseline, 985 (92.0%) completed the 24-month assessment and were included in the current analyses. In the third year of the study, an additional 128 GBM of color were recruited into the study and
received the 24-month assessment as their first assessment. This brings the full sample total to 1,113—however, the current analytic sample ($N = 927$) excluded those who reported no alcohol use in the past 12 months, as the questions regarding alcohol use motivations would not be applicable.

**Procedure**

Participants in *One Thousand Strong* completed the online survey via a unique link that was emailed to them and were compensated with a $25 Amazon gift card for completion of the Qualtrics CASI survey. All protocols were approved by the Hunter College Institutional Review Board.

**Measures**

**Demographics.** Participants reported their birthdate (from which current age was calculated), race and ethnicity, relationship status, sexual orientation, annual income, and education level.

**Drinking alcohol to stay awake.** Participants were asked to choose the answer that best describes them (displayed for those who reported recent alcohol use): “If you are out socializing at night and are becoming tired, do you drink alcohol to help stay awake for longer?” Responses were on a scale from 0 (*Never*), 1 (*Sometimes*), 2 (*Quite often*), to 3 (*Very often*).

**Drinking alcohol mixed with energy drinks to stay awake.** Participants were asked to choose the answer that best describes them (displayed for those who reported recent alcohol use): “If you are out socializing at night and are becoming tired, do you drink alcohol mixed with energy drinks (e.g., Red Bull, coke, coffee, etc) to help stay awake for longer?” Responses were also on a scale from 0 (*Never*), 1 (*Sometimes*), 2 (*Quite often*), to 3 (*Very often*).
**Chronotype.** Chronotype was measured using a widely-used modified version of the five-item MEQ-R (Adan & Almirall, 1991). The modified scale is displayed in Appendix 1. Response items to each of the five items vary and are weighted in their scoring. In accordance with Adan and Almirall’s (1991) recommendation, the following five groups can be classified: definitely morning type (22-25); moderately morning type (18-21); neither type (12-17); moderately evening type (8-11), and; definitely evening type (4-7). These groups were combined into three chronotype categories: morning types, neither type, and evening types.

**Analytic Plan**

Descriptive statistics summarize the demographic characteristics of the full One Thousand Strong sample, with comparisons between the analytic sample (i.e., those reporting recent alcohol use) and those who were excluded for reporting no alcohol use in the last 12 months. These comparisons utilized $\chi^2$ tests of independence for categorical variables and an independent samples $t$-test for age as a continuous variable. Where omnibus tests of significance indicated, follow-up tests of between-group differences were conducted, as indicated by superscripts.

Further, $\chi^2$ tests of independence tested whether frequencies of those reporting use of alcohol to stay awake or not (whether alcohol and/or alcohol mixed with energy drinks) differed according to the three chronotype groupings: morning types, neither types, and evening types. An independent samples $t$-test tested whether those reporting the alcohol item differed in age from those who did not endorse the item.

In a multivariable binary logistic regression predicting the odds of reporting the use of alcohol and/or alcohol mixed with energy drinks to help stay awake longer, age (continuous and centered) and chronotype (with morning types as the referent) were entered in a stepwise
fashion. Improvement in model fit with the addition of chronotype as a predictor is indicated by Model and Step $\chi^2$ statistics and inspection of fit statistics, the percentage correctly classified and the Hosmer and Lemeshow $\chi^2$ (where a significant result indicates non-improved model fit).

**Results**

As displayed in Table 4, the *One Thousand Strong* sample was predominantly White (61.5%), gay (95.3%), and relatively high in education level (93.8% reported having at least some college-level education). The average age of the sample was 41.4 years, ranging from 19 to 81, and 51.3% reported being in a relationship. In terms of chronotype, 21.6% of participants were scored as a morning type, 49.9% as neither type, and 28.6% as an evening type. It should be noted that those with an evening chronotype were significantly younger ($M = 36.7, SD = 12.3$) than morning types ($M = 49.0, SD = 13.0$) and neither types ($M = 40.7, SD = 13.2$), $F (2, 1110) = 63.71, p < 0.001$. Of the 1,113 men, 927 (83.3%) reported alcohol use in the past 12 months and thus constituted the analytic sample for subsequent analyses. Compared to the 186 (16.7%) who reported no alcohol use in the past 12 months, the analytic sample was, on average, younger and included a greater proportion of Latino men and a smaller proportion of White men.

As displayed in Table 5, of the 927 men reporting recent alcohol use, a total of 492 (53.1%) indicated use of alcohol (whether with or without energy drinks) to help them stay awake longer. Of these, 218 indicated use of both alcohol and alcohol mixed with energy drinks to help them stay awake longer, while 153 reported drinking alcohol to stay awake but not the use of alcohol mixed energy drinks, and 121 indicated drinking alcohol mixed with energy drinks to stay awake longer but not alcohol without energy drinks.

Comparing these 492 men with the 435 (46.9%) alcohol-using men who did not report use of alcohol to help stay awake, Table 5 displays the bivariate analyses of these two groups by
age and chronotype. Those reporting alcohol use (whether with or without energy drinks) to help them stay awake longer were, on average, younger and were less likely to be morning types than those indicating that they do not—43.8% of morning types indicated that they do so at least sometimes, compared to 53.7% of neither types and 58.7% of evening types. The distributions by chronotype are depicted in Figure 4. Younger age was significantly associated with use of alcohol to stay awake—while more than two-thirds (67.1%) of men aged below 30 reported use of alcohol to stay awake, only 38.3% of men aged 50-59 and 22.5% of men aged 60 or older did so. In a multivariable context, younger age was a significant predictor of increased odds of indicating use of alcohol (whether without and/or with energy drinks) to stay awake longer. However, chronotype was not significant, when adjusting for age. The addition of chronotype to the model in the second step did not increase the model fit statistics, as displayed in Table 6.

**Discussion**

The current findings support Hypothesis 3 that most GBM—here, 53.1% of those who use alcohol—sometimes use alcohol (without and/or with energy drinks) to help them stay awake if they are out socializing and are feeling tired. In other words, tiredness is a factor that can motivate or increase alcohol use for the majority of alcohol-using GBM. Further analyses showed that younger age was associated with increased odds of reporting this usage of alcohol. That this motivation for alcohol use is more commonly reported among younger GBM is concerning given that rates of problem drinking and substance use are also pronounced among younger GBM compared to their heterosexual counterparts (Marshal et al., 2008). This finding may be partly explained by the findings of Aim 1 which showed that younger GBM are more likely to report later peak drinking times (9pm or later) than older men. While chronotype was associated at the bivariate level, the frequencies of reporting use of alcohol to stay awake did not
meaningfully differ according to chronotype grouping when adjusting for their considerable differences in age.

Previous studies on the use of energy drinks in alcohol have suggested that energy drinks are frequently used to counter the sedative effects of alcohol (Snipes & Benotsch, 2013; Wells et al., 2013). Our findings extend this by suggesting that energy drinks with alcohol are also used to help GBM stay awake longer when becoming tired, whether from sleep deficiency or from alcohol’s sedative effects. This is relevant given findings of Aim 1 showing that alcohol use most often occurs at night which is when people are more likely to become tired. This resonates with a quote from an 18 year old male in a qualitative study by Pettigrew et al. (2016) about alcohol and energy drink use:

“At most house parties or pre-drinks, my first drink will be an energy drink with vodka. I start with an energy drink because it wakes and livens me up immediately so I can get into the party fast and don't need to wait for the alcohol to kick in. It makes me feel drunk sooner and more energetic, which is perfect for house parties with friends” (p. 412)

The use of alcohol mixed with energy drinks is, in itself, concerning given findings that such use is associated with increased drinking overall, increased alcohol-related harm, and increased energy but not decreased alcohol-related impairments in simple motor tasks and many complex tasks (see McKetin, Coen, & Kaye, 2015, for a review). Some research suggests that consumption of alcohol mixed with energy drinks actually increases the desire for more alcohol (Marczinski, Fillmore, Henges, Ramsey, & Young, 2011) and increases one’s ability to drink for longer periods of time (Attwood, Rogers, Ataya, Adams, & Munafo, 2012). This issue of mixing energy drinks with alcohol appears important for the sexual health of GBM given findings that such use has been associated with sexual risk-taking among mostly heterosexual samples.
(Berger, Fendrich, & Fuhrmann, 2013; Miller, 2012; Peacock & Bruno, 2015; Snipes & Benotsch, 2013) and with stronger expectancies that their use will improve sexual performance and arousal (Lau-Barraco, Milletich, & Linden, 2014). Wells and colleagues (2013) also offered evidence that rates of drinking alcohol mixed with energy drinks were greater among sexual minority individuals compared to their heterosexual counterparts, and among males compared to females. Accordingly, links between use of alcohol with energy drinks and subsequent sexual risk-taking among GBM warrant further investigation.

Separate to the issue of energy drinks, the current findings have shown that a substantial proportion of GBM reported drinking alcohol without energy drinks to help them stay awake longer, which resonates with the work of Hendler and colleagues (2013) regarding the stimulatory effects of alcohol. While this motivation to drink in order to combat tiredness is reflected in colloquialisms such as having a “pick-me-up” or a “livener”, and has been included in recent scales regarding use of alcohol mixed with energy drinks, the current finding that a substantial proportion of men use alcohol without energy drinks to stay awake suggests that this motivation should be included amongst general drinking motives (regardless of energy drink usage).

Alongside the strengths of the One Thousand Strong study, such as the size and nationwide reach of its sample, is its limitation in terms of the generalizability of the sample, which is predominantly White and relatively high in education and income levels. Future research could explore these associations among samples comprised of a greater number of racial and ethnic minority and low SES GBM. Future research could also aim to explore this motivation for drinking in a less global, survey-based fashion, by collecting daily diary data to explore event-level associations of this drinking behavior, both in terms of which factors may
contribute to such a drinking motive as well as which subsequent behaviors may result from it. Future research could explore whether there are relevant demographic differences between GBM those reporting use of alcohol to help them stay awake, such as racial/ethnic differences, urban vs. rural differences, and socioeconomic differences, as this may help with the detection of disparities in alcohol use patterns among GBM and with the tailoring of interventions.

In sum, the findings of the current chapter contribute substantially to our understanding of another of the motivating factors in alcohol use among GBM. It has provided compelling evidence for the addition of a new and previously under-explored motivation in alcohol research (outside of the energy drink literature): using alcohol to help stay awake. The detection of younger age as an associated factor in this motivation for drinking highlights the need to better understand drinking motives in younger GBM and the factors promoting it, and to help GBM—particularly younger GBM—to better prepare for anticipating, preventing, or coping with tiredness, and to raise awareness of links between one’s sleep health and one’s alcohol use.
CHAPTER FOUR

Aim 3: Day-Level Associations Between Sleep Quality and Subsequent Alcohol Use

In order to gather evidence on whether previous night’s sleep quality predicts alcohol use on a given day, data were analyzed from the daily diary component of the day2day study. As stated in the Introduction, the goal of this aim was to test the following two hypotheses: that previous night’s sleep quality will be associated with greater odds of subsequent alcohol use (vs. no use) on a given day (Hypothesis 4) and; that previous night’s sleep quality will be associated with greater odds of heavy drinking (vs. drinking only 1-4 drinks) on a given day (Hypothesis 5).

Method

Participants

Data were drawn from 52 participants enrolled in day2day, a 21-day daily diary study of HIV-positive GBM in the New York City metropolitan area (Rendina et al., under review). The day2day study was advertised as a mobile health study aimed at understanding health behaviors in GBM across a 21-day period. Recruitment efforts for the study included active online strategies such as online recruitment, including advertisements on social media websites and sexual networking apps (e.g., Vial, Starks, & Parsons, 2015). Participants were invited to complete an initial online screener, assessing eligibility in regards to HIV-status, age, male gender, and gay or bisexual sexual orientation/identity. Preliminarily eligible participants were then contacted by research staff to complete a more in-depth screener assessing whether the participant reported recent drug use (two or more days of club drug use in the past 30 days), recent HIV transmission risk behavior (one or more act of CAS with a negative/unknown partner, excluding main partners who were on PrEP), being prescribed anti-retroviral therapy (ART) medications, and having daily access to the internet via smartphone. Eligible and
interested participants were then invited to complete an online CASI and attend an in-person baseline appointment at our research center during which proof of HIV-positive status was confirmed by verifying a prescription bottle with their name on it, and a timeline follow-back (Sobell & Sobell, 1996) interview was conducted to assess the number of days of medication adherence, substance use, and sexual behavior in the previous 30 days. This led to an analytic sample of 52 HIV-positive GBM. Upon enrollment, participants were instructed in completing the twice-daily daily diary assessments, data from which are the focus of these analyses.

Procedure

After completion of the baseline measures and enrollment into the study, participants were asked to complete diary surveys that were sent twice daily—one in the afternoon and one in the evening—for a period of 21 days. Participants were given four hours to respond to each survey (12:00pm to 3:59pm, and 8:00pm to 11:59pm respectively). Incomplete surveys were coded as missing data. Participants were compensated $50 for the baseline assessment, $1 for completion of each of daily diaries in the first week, $2 for completion of each of the second week’s diaries, and $3 for completion of each of the third week’s diaries. All protocols were approved by the Hunter College Institutional Review Board.

Measures

**Baseline demographics.** Participants reported a variety of demographic characteristics in the screener and baseline survey, including age, race and ethnicity, educational level, income, relationship status, and number of years living with HIV.

**Previous night’s sleep quality.** In each afternoon survey, participants rated their previous night’s sleep quality on an 11-point scale of zero-to-five stars with half-stars available, in response to a single item question: “Overall, how would you rate the quality of your sleep last
night?” Previous studies have used a single item for measuring subjective sleep quality (Bouwmans et al., 2017; Fung, Nguyen, Moineddin, Colantonio, & Wiseman-Hakes, 2011; McCrae et al., 2008; Ong et al., 2013). These data were disaggregated into their within-person and between-person components, following procedures that have been used in previous daily diary studies (Eldahan et al., 2016; McCrae et al., 2008; Rendina, 2014; Rendina et al., under review):

**Within-person sleep quality.** The mean sleep quality of each participant across the assessment period was calculated as an average of their daily ratings. The subtraction of the individual’s mean sleep quality from each day’s rating generated a person-mean centered score representing one’s daily fluctuation in sleep quality or within-person deviation from one’s own average. This was used as a Level 1 predictor whereby negative scores indicate worse-than-usual sleep quality and positive scores indicate better-than-usual sleep quality.

**Between-person sleep quality.** All participants’ responses generated a grand mean of sleep quality, and each individual’s own average sleep quality had this grand mean subtracted from it (i.e., centered with respect to this grand mean), such that an individual with mean sleep quality below zero represented poorer sleep quality than the sample’s average, while means above zero represented higher quality of sleep at the between-subject’s level. This centering approach—as recommended by previous research (Bolger & Laurenceau, 2012, Curran & Bauer, 2011)—was undertaken so that reference could be made to how the individual compares to the larger sample in terms of overall or typical sleep quality.

**Day-level engagement in any alcohol use.** Participants’ daily report of alcohol use, reported the following day, was coded as a dichotomous outcome variable indicating whether there was any alcohol use on a given day, where 0 = none and 1 = any alcohol use.
**Day-level engagement in heavy drinking.** Participants’ alcohol use was also scored as a trichotomous variable, where no drinking was coded as a 0, drinking one-to-four drinks was coded as a 1 (which is considered to be non-heavy drinking), and drinking five or more drinks (termed “heavy drinking”) was coded as a 2. This adapts the coding of sexual behavior employed in Rendina (2014).

**Analytic Plan**

Simple descriptive statistics summarize the demographic characteristics of the day2day sample. Multilevel modelling was employed to test the hypotheses that an individual’s day-to-day fluctuations in previous night’s sleep quality—as a Level 1 predictor—would be associated with increased odds of engaging in any alcohol use (i.e., any drinking vs. no drinking) in a binomial model (Model A) and separately with the odds of heavy drinking (i.e., drinking five drinks or more vs. drinking fewer than 5 drinks on a day of drinking) within a multinomial model (Model B).

These models were run as logistic multilevel models, with day as a repeated measures variable and participant ID as the grouping variable. Prior to MLM analyses, a bar plot was created to visually inspect whether there was variability between individuals in their average odds of alcohol engagement and of heavy drinking. In line with the recommendations of Rendina and colleagues (2016), both models adjusted for the effect of time across the daily diary reporting period (i.e., the day centered at Day 11 of 21 days, with the earlier period of Days 1 to 11 as the referent category) and for the effect of weekend days of reporting (Friday, Saturday, and Sunday vs. all other days as the referent category). In order to account for the stronger correlation between days that are closer to each other than days set further apart, the covariance matrix structure was specified as first-order autoregressive, or AR(1). In sum, both models
adjusted for the effects of age (centered) and average sleep quality (person-centered)—as Level 2 predictors—and day of reporting, and whether it was a weekend or weekday—as Level 1 predictors.

**Results**

The *day2day* sample consisted of 52 HIV-positive GBM recruited from the New York City area. On average, the men were 38.7 years old (*SD* = 10.2), ranging from 22 to 67 years in age. The majority of the sample reported being single (73.1%), of a racial/ethnic minority (68.8%), and earning less than $30,000 annually (59.6%). Demographic details are summarized in Table 7. These 52 participants completed between two and 21 of their afternoon diary entries per day for a total of 803 reports, from a possible maximum of 1,092 entries, as displayed in Figure 5. This represents an average of 15.4 days per participant. However, only 642 days had entries completed on the next day from which drinking reports could be lagged back or matched. As SPSS Version 24.0 utilizes pseudo maximum likelihood estimation for multilevel models using categorical outcomes, missingness was not estimated. Participants’ daily afternoon ratings of last night’s sleep quality generated a mean sleep quality of 3.05 (*SD* = 0.85), on the scale of 0 to 5, where these means among individuals ranged from a mean sleep quality of 0.77 to 4.71.

**Odds of engagement in any drinking (vs. no drinking) on a given day**

Figure 6 displays the variability in participants’ odds of reporting days of any drinking. Participants indicated odds of drinking ranging from 0.0 (indicating no days of drinking reported) to 1.0 (indicating drinking on 100% of days reported). There were 184 reports of days of drinking out of a possible 642 reports, and accordingly the odds of drinking on a given day, without accounting for nesting within individuals, was 184/457 = 0.40.
As displayed in Table 8, Model A contained the fixed effects of between- and within-person sleep quality, and the random effect of the intercept and within-person sleep quality, adjusting for the effect of age (centered), the day of reporting, and the day being a weekend (referent: non-weekend days). Results show a non-significant adjusted odds ratio for within-person sleep quality of 0.97 ($p = 0.76$), indicating that day-to-day fluctuations in sleep quality have no day-level association with the odds of engaging in any drinking on a given day.

**Odds of engagement in heavy drinking (vs. drinking 1-4 drinks)**

Figure 7 displays the variability in participants’ odds of reporting days of heavy drinking. Participants indicated odds of heavy drinking ranging from 0.0 (indicating no days of heavy drinking reported) to 0.5 (indicating heavy drinking on 33% of days reported). There were 56 reports of days of heavy drinking out of a possible 642 reports, and accordingly the odds of heavy drinking on a given day, without accounting for nesting within individuals, was $56/586 = 0.10$. However, these 56 events of heavy drinking were out of the total 184 drinking days, and accordingly the odds of heavy drinking on a day of having any drinks, without accounting for nesting within individuals, was $56/128 = 0.44$.

As displayed in Table 8, the results for Model B show a non-significant adjusted odds ratio of 1.20 ($p = 0.35$), indicating that day-to-day fluctuations in sleep quality have no day-level association with the odds of engaging in heavy drinking (vs. drinking fewer than five drinks) on a given day of drinking.

**Discussion**

The current analyses of day2day data, which tested for day-level associations between ratings of previous night’s sleep quality and subsequent alcohol use and heavy drinking on a given day, did not find significant associations with either drinking outcome among a sample of
52 HIV-positive GBM based in New York City. Thus, Hypotheses 4 and 5 were not supported. However, the almost-zero association between previous night’s sleep quality and the odds of engaging in any alcohol use on a given day is an indication that worse-than-usual sleep quality from the previous night does not appear to diminish the odds of subsequent drinking. In other words, alcohol use on a given day is not dampened or impeded by having had worse-than-usual sleep quality the night before. The second stage of analyses found that the odds of engaging in heavy drinking (vs. drinking some alcohol but fewer than five drinks) were also not significantly predicted by previous night’s sleep quality. In other words, worse-than-usual sleep quality from the previous night did not dampen or impede the odds of subsequent heavy drinking relative to drinking between one and four drinks on a given day. Further, person-level sleep quality was not associated with either outcome.

Though null, these findings are noteworthy firstly because they do not support the assumption that being tired would necessarily dampen one’s engagement in the active behavior of drinking—indeed, the null finding in Model A indicates that, although tiredness is not associated with subsequent drinking, many drinking days reported by the GBM in this small sample occurred on days following a night of worse-than-usual sleep quality. This is concerning for the physical health of GBM living with HIV, given associations between alcohol use and poorer physical and neurological health as substantiated by research on the general population (Schmidt & Popham, 1975; Topiwala et al., 2017), and for HIV-related outcomes such as immunologic functioning, progression of HIV, medication adherence in HIV-specific studies (Hendershot, Stoner, Pantalone, & Simoni, 2009; Samet et al., 2007). Studies have also shown associations among GBM between alcohol use and mental health outcomes such as depression and anxiety (Cochran, Mays, Alegria, Ortega, & Takeuchi, 2007). It is also concerning that many
GBM may also be making drug use decisions and sexual risk-taking decisions within or following the same drinking event under the effects of tiredness, whose impairments are likely exacerbated by alcohol-related intoxication in general.

Some of the limitations of the *day2day* study include the relatively small number of heavy drinking days out of the total number of diary days observed with which to detect an association. Additionally, many reported days were followed by missing reports on the next day, which meant that the behavioral outcome (i.e., drinking) could not be matched back to the previous day’s rating of sleep quality, thus preventing inclusion in these analyses. More consistent completion of the daily dairies would have resulted in a greater number of matched days to include in analyses. The *day2day* sample of 52 HIV-positive men living in New York City was predominantly of a racial/ethnic minority and of low income and education level, reflecting some of the racial/ethnic and other socioeconomic health disparities of the HIV epidemic. Almost half of the men (49%) reported being unemployed and this may mean that the more conventional lifestyle of full-time Monday-to-Friday daytime work schedules may be under-represented in the current sample, potentially affecting sleep, tiredness, and the timing of social activities like drinking across the week. As a result of these characteristics, the current findings may not be generalizable to other HIV-positive GBM populations or to HIV-negative GBM. A further limitation is that the study did not ask participants about their general objective sleep health, which may be important given that previous research has noted comparatively poorer sleep in HIV-positive individuals and that sleep disturbance is commonly associated with worse immunologic functioning (Cruess et al., 2003). It may be that almost all of these men have relatively poor sleep health and are chronically under the impairments of less-than-optimal sleep
quality, and that day-level associations between sleep quality and subsequent behaviors are more pronounced in people who typically sleep well.

In sum, the current study observed no day-level associations between worse-than-usual sleep quality the night before and subsequent engagement in any drinking or in heavy drinking among a sample of HIV-positive GBM in New York City. In other words, alcohol use was not impeded or precluded by having had poor sleep the night before.
CHAPTER FIVE

Aim 4: Time of Day When Sex Most Commonly Occurs

In order to gather data on when sex with casual male partners most commonly occurs among HIV-negative GBM and whether timing varies by age and chronotype, a range of questions devised by the author were added into the 24-month assessment in the One Thousand Strong study. As stated in the Introduction, the goal of this aim was to test the following two hypotheses: that the majority of GBM surveyed will report that their most recent event of anal sex (both without condoms, here CAS, and with condoms) with a casual male partner will have occurred during the evening and night compared to daytime (Hypothesis 6); and that the odds of sex having occurred from 9pm onwards will be greater among younger men and among evening types (Hypothesis 7).

Method

Participants and Procedure

See Chapter 3.

Measures

Demographics. Participant age was derived from demographic data as reported in Chapter 3 and, for the analytic sample included in logistic regression analyses, was mean-centered. The same demographic characteristics as described in Chapter 3 were also utilized—race and ethnicity, sexual identity, relationship status, income, and education.

Chronotype. As in Chapter 3, chronotype was derived from scores on the five-item MEQ-R (Adan & Almirall, 1991) and was categorized into three groupings: morning, neither, and evening types.
Timing of most recent sexual risk-taking event with a casual partner. All participants were asked to indicate the time of day that their most recent event of CAS with a casual male partner had occurred. In response to the stem “Thinking back to the last time you had anal sex with a casual partner, WITHOUT a condom, was it during the day or during the night?”, participants indicated whether: 1 (It was during the day), 2 (It was during the night), or 3 (Not applicable, I have never had anal sex with a casual partner WITHOUT a condom). If participants answered a) or b), they were then asked to recall the approximate time of that event from a drop-down menu in the format of --:--am/pm (to the closest half-hour). These times were grouped into: daytime (from 6am up to 5pm), evening (from 5pm up to 9pm), night (from 9pm up to midnight), and after midnight (from midnight to 6am).

Timing of most recent event of anal sex with a condom with a casual partner.

Participants were also asked the exact same series of questions as described above in relation to their most recent event of anal sex with a condom with a casual male partner.

Analytic Plan

Although all men in the full sample were asked about the timing of their last sex event (CAS and sex with a condom) with a casual male partner, the questions did not ask participants to specify how recent these events were. Thus, it is possible that the most recent event to which some men may have been referring could have occurred many years or decades ago, when their age and likely chronotype would have been substantially different. Accordingly, subsequent analyses limited this analytic sample to those who reported having had both CAS and sex with condoms with a casual male partner within the past year. Excluding those with more distal events by limiting events to the last year increases the precision of the analyses regarding age and chronotype. Comparisons were conducted between those included and excluded from subsequent
analyses on various demographic variables, chronotype, and timings of last sex events. Where omnibus $\chi^2$ tests of significance indicated, follow-up tests of between-group differences were conducted as indicated by superscripts.

Regarding the timing of last sex event, $\chi^2$ tests of independence for differences by chronotype, and one-way ANOVA tests of age among the four different time ranges were conducted. Superscripts indicate group differences for chronotype differences and estimated marginal means in generalized linear regressions for age, with significance set at $p < 0.05$.

At the multivariable level, separate binary logistic regressions were run to predict the odds of reporting times of last sex event (separately for CAS and sex with condoms) from 9pm onwards (combining both 9pm-midnight, and midnight onwards) compared to daytime/evening grouped together. In step one of each model, age (continuous and centered) was entered alongside covariates of race/ethnicity (with White as the referent category) and income (with $50K or more as the referent category). In step two, chronotype (categorical, with morning type as the referent category) was entered. Improvement in model fit was indicated by Model and Step $\chi^2$ statistics and inspection of fit statistics, the percentage correctly classified and the Hosmer and Lemeshow $\chi^2$ (where a statistically significant result indicates that the covariance matrix implied by the specified model deviates significantly from that observed in the data).

Additionally, it should be noted that some men may have reported being on PrEP at the time of the survey, but as it cannot be confirmed that they were on PrEP at the time of the sex events they were referring to, PrEP status and their partner’s status were not addressed in the current analyses.
Results

As displayed in Table 9, 809 (72.7%) of the full sample indicated that they have had CAS with a casual male partner at some point in their life, whereas 304 (27.3%) indicated that they had not. Of the 809 men, the majority (69.8%) reported that their most recent CAS event had occurred at night, either in the evening (16.1%), from 5-9pm (24.6%), or after midnight (29.2%). Only 30.2% reported that it had occurred during the day. However, only 344 (30.9%) men had reported both recent CAS and sex with condoms with a casual male (i.e., were reporting on events that had occurred in the past year). The distributions of timing of last CAS event did not differ amongst those in the analytic sample for subsequent analyses and those who were excluded for not having reported both types of recent sex with a casual male partner (n = 769). Among the full sample, 958 (86.1%) reported having had sex with condoms with a casual male partner at some point in their life. Of these, more than two-thirds (69.3%) reported that their most recent event had occurred during the night: either in the evening (17.6%), from 5-9pm (27.7%), or after midnight (24.0%). Only 30.7% reported it occurring during the day. These distributions also did not differ amongst those included or excluded from the analytic sample. However, the two groups did differ on age, race and ethnicity, and relationship status. The included group was, on average, younger and consisted of a greater proportion of Black men and single men and a smaller proportion of White men than the excluded group.

As displayed in Table 9, the demographic characteristics of the analytic sample revealed an average age of 38.3 years (SD = 12.8). More than half of this sample was White (54.7%), single (68.3%), and earning below $50,000 per year (51.2%), and had at least some college-level education (93.9%). The vast majority of the sample was gay (94.5%), and their chronotype distributions were morning types (18.0%), neither types (52.3%), and evening types (29.7%). It
should be noted that those with an evening chronotype were significantly younger ($M = 34.2$, $SD = 10.1$) than morning types ($M = 46.5$, $SD = 13.3$) and neither types ($M = 37.8$, $SD = 12.0$), $F$ (2, 341) = 21.67, $p < 0.001$.

As shown in the top section of Table 10, of the 344 men who were reporting in relation to a CAS event that had occurred recently, the majority (68.6%) indicated that the event had occurred in the evening or night—most commonly after midnight (25.9%), followed by 9pm to midnight (23.5%), and from 5-9pm (19.2%). Only 31.4% of CAS events were reported to have occurred during the day (i.e., 6am to 5pm). Bivariate analyses revealed that the frequencies of these timings differed by age but not by chronotype. Men reporting later times of last CAS, particularly after midnight, were on average younger. While a greater percentage of men with an evening chronotype (34.3%) reported CAS occurring after midnight than men with a morning (19.4%) or neither (23.3%) chronotype, the omnibus test for this comparison did not reach significance.

The lower section of Table 10 shows the frequencies of timings for most recent event of sex with condoms with a casual male partner. Almost as many men (65.4%) reported that their most recent event of sex with condoms had occurred at night as did those reporting on CAS (68.6%)—most commonly, between 9pm and midnight (26.5%), followed by after midnight (20.1%), and between 5-9pm (18.9%). In contrast to CAS results above, bivariate analyses revealed that the frequencies of these timings of sex with condoms differed by chronotype but not by age. A greater proportion of morning types (48.4%) reported sex with condoms during the day than did those with an evening (22.5%) or neither (36.7%) chronotype. Only 11.3% of morning types reported that their most recent sex with condoms occurred after midnight, whereas
19.4% had reported that their most recent CAS had occurred after midnight. Distributions of times for both CAS and sex without condoms are depicted in Figure 8.

In multivariable analyses, as displayed in Table 11, younger age was significantly associated with the odds of last CAS occurring from 9pm onwards (vs. during the day/evening), while chronotype was not, when adjusting for age. The addition of chronotype in the second step of the model did not contribute significantly to model fit. Conversely, as displayed in Table 12, chronotype but not age was significantly associated with odds of last sex with condoms occurring from 9pm onwards (vs. during the day/evening). After adjusting for age, morning types were less likely to report sex with condoms occurring from 9pm onwards than were evening types. The addition of chronotype in the second step of the model did contribute significantly to improved model fit, and rendered age non-significant.

**Discussion**

The current findings revealed that, among men in the national *One Thousand Strong* cohort, anal sex with casual male partners (whether without or with condoms) most commonly occurs during the evening, night, or after midnight. Indeed, roughly two out of three recent anal sex acts with a casual male partner were “nighttime” events—and this pattern was consistent between the full sample and the analytic sample (i.e., those reporting on past-year events). These findings provide support for Hypothesis 6 and are largely consistent with the small handful of studies that have looked at time of sex among heterosexuals (Barak et al., 1997; Jankowski et al., 2014; Palmer et al., 1982; Refinetti, 2005), although those studies did not explore condom use. In those studies, the most commonly reported times of sex were between 11pm and 1am (Refinetti, 2005), between 10pm and 1am (Palmer et al., 1982), evening or night (Barak et al., 1997), and from 6pm until midnight (Jankowski et al., 2014).
The current findings thus represent the first attempt, to my knowledge, to explore timing of sex among GBM and with respect to condom use. The only study, to my knowledge, that has explored timing of sex-related activity among GBM, but not actual sex per se, is Goedel and Duncan’s (2015) study of peak usage of Grindr, a sexual networking app, finding that 75% of GBM most often use Grindr in the evening or late at night. This accords with the current findings that almost 70% of our GBM reported recent casual sex in the evening, night, or late at night.

The current findings also revealed that age and chronotype are important factors for the timing of casual sex for GBM, supporting Hypothesis 7 though with the following qualifications. Younger age was associated with increased odds of reporting later times of CAS, but not sex with condoms, when adjusting for chronotype. It should be noted that, in our sample, those with an evening chronotype were significantly younger than morning types and neither types. As was stated in Chapter 2, this is consistent with chronobiology research showing that younger men tend to have a later chronotype than older men (Duarte et al., 2014; Randler, 2016; Roenneberg et al., 2007). However, the current multivariable analyses showed that the influence of chronotype only persisted when adjusting for age in relation to sex with condoms, not CAS. The addition of chronotype in the second step of the regression models significantly contributed to model fit in the timing of sex with condoms but not for the timing of CAS.

Results showing the association between chronotype and later times for sex with condoms suggest that sex with condoms is an act that tends to align with men’s circadian preference more closely than does sex without condoms—and this potentially implicates levels of energy, effort, alertness, and/or self-regulation. However, a substantial proportion of morning types and neither types reported having sex without condoms late at night, at a time when they would be expected to be in their circadian off-time. Furthermore, a slightly greater proportion of
men reported after-midnight sex without condoms (25.9%) than sex with condoms (20.1%), also potentially implicating their circadian off-time in their non-use of condoms.

Additionally, it should also be noted that the overall percentages of those reporting ever having experienced either type of casual sex were lowest among morning types. This is partially consistent with a range of chronobiology research in which evening types are generally found to be riskier than morning types (Ponzi, Wilson, & Maestripieri, 2014). Furthermore, the results of the current study also roughly accord with the findings of Jankowski and colleagues (2014) who found that males with a later chronotype were more likely to report peak sexual desire and sexual activity later at night (between 9pm and 3am) than other males (between 6pm and midnight).

A limitation of the current study is that we only asked participants about their most recent event of each type of sex. More nuanced data about frequencies of differing times might be gained in more in-depth survey studies and daily diary studies. Future studies could include questions about whether the participant had already slept prior to the sex event—as, in the current study, it cannot be confirmed that an individual reporting sex at 6:30am might not have still been awake from the night before. It should be noted that this study cannot confirm whether the timing of these events might differ if participants had also consumed alcohol or stimulant drugs prior to the event. Information on sex with main partners may also be important for sexual health and HIV/STI prevention. More detailed information on lifestyle factors for these men would be relevant, such as whether they are shift-workers or live by nocturnal schedules. Finally, the classification of sexual risk here did not account for the individual’s PrEP status nor the HIV status of the casual partner with respect to HIV, detectability, and/or PrEP.

In sum, the current findings substantiate what many people may have guessed—that casual sex among GBM is primarily a nighttime activity and that later times for sex are more
commonly reported by younger men and those with a later chronotype. While having an evening chronotype was significantly associated with reporting later times of sex with condoms but not CAS, younger age was significantly associated with later times of CAS but not sex with condoms. Perhaps less expected is the finding that a substantial number of morning types reported having had sex with a casual partner very late at night (from midnight onwards), presumably when their self-regulatory capacities are expected to be impaired. Further research is needed to examine whether the lateness of the hour when casual sex occurs might be inadvertently introducing factors such as tiredness or sleep-related fatigue into the decisions that GBM are making about their sexual health or about whether to engage in other health-compromising behaviors such as the use of alcohol or drugs before or during sex.
CHAPTER SIX

Aim 5: The Role of Tiredness in Sexual Desire and Sexual Positioning

In order to gather evidence of the effect of tiredness on sexual desire and sexual behavior, a range of questions were devised by the author and were added into the 24-month assessment in the *One Thousand Strong* study, in addition to questions regarding age and chronotype that were previously described in Chapters 3 and 6. As stated in the Introduction, the goal of this aim was to test the following two hypotheses: firstly, that tiredness does not uniformly reduce the possibility of sexual desire (Hypothesis 8). In other words, many GBM will report that, when tired, they are still likely to feel sexual desire, and may actually report increased sexual desire. Secondly, GBM will report that being tired can increase their odds of being the receptive partner in anal sex (Hypothesis 9). No hypotheses regarding age and chronotype are advanced in relation to either Hypothesis 8 or 9. However, as it appears less likely that men who identify strictly as the insertive partner in anal sex would be willing to change their sexual positioning (from being the “top” to being the “bottom”), checks by usual sexual positioning identity will be explored for Hypothesis 9.

Method

Participant and Procedure

Details are as stated in Chapter 3.

Measures

In addition to the measures in the *One Thousand Strong* study already described in Chapters 3 and 6 for age and chronotype, participants were also asked about the effects of tiredness on sexual desire and on their preference for sexual positioning in anal sex. Men were also asked about their usual preference for positioning in anal sex in order to explore whether
changes in sexual positioning when tired are more common among men who report a versatile positioning identity.

**Tiredness on sexual desire.** In response to the stem “After I’ve had a long day…”, participants were asked to choose the answer that best describes them from among the following options: 1 (Being tired doesn’t reduce my libido/sex drive at all [i.e., it has no effect on my ability to become sexually aroused]), 2 (Being tired reduces my libido/sex drive a little bit), 3 (Being tired reduces my libido/sex drive a lot), or 4 (Being tired reduces my libido/sex drive completely [i.e., I will not become aroused if I am tired]). Secondly, participants were also asked to answer true or false to the statement: “Sometimes, being tired actually increases my libido/sex drive,” with “true” coded as a 1 and “false” coded as a 0.

**Usual sexual positioning identity.** Participants were asked to indicate whether they consider themselves to be a “top” (the insertive partner in anal sex), a “bottom” (the receptive partner in anal sex), or “versatile” on the following scale: 1 (Top), 2 (Versatile/Top), 3 (Versatile), 4 (Versatile/Bottom), or 5 (Bottom).

**Tiredness on positioning in anal sex.** In response to the stem “If I am tired but I am still wanting to have anal sex…”, participants chose one of the following options: 1 (Being tired would not change my preference for being a “top” or a “bottom”), 2 (Being tired would probably make me more likely to “bottom”), or 3 (Being tired would probably make me more likely to “top”).

**Analytic Plan**

Descriptive statistics show the frequencies for each response to the above question of whether being tired reduces or increases sexual desire or increases odds of receptive sex for the whole sample and when split by chronotype (morning, neither, and evening), by usual sexual
positioning identity, and by age. For each question, $\chi^2$ tests of independence analyses tested for differences by chronotype and usual sexual positioning identity, and independent samples t-tests or one-way ANOVAs tested for differences in age as a continuous variable. Where omnibus $\chi^2$ tests of significance indicated, follow-up tests of between-group differences were conducted for categorical variables and using estimated marginal means in generalized linear regressions for age as a continuous variable, with differences indicated by superscripts.

Binary logistic regressions predicting endorsement of the statement that “being tired can sometimes increase my libido/sex drive” considered the predictors of age (continuous and centered) and chronotype (in the three groupings) in a stepwise progression. Similarly, binary logistic regressions predicting endorsement of the statement that “being tired would probably make me more likely to bottom” explored the predictors of age (continuous, centered) and usual sexual positioning identity (in the five groupings as described above) in stepwise progression. In both analyses, improvement in model fit is indicated by Model and Step $\chi^2$ statistics and inspection of fit statistics, the percentage correctly classified and the Hosmer and Lemeshow $\chi^2$ (where a significant result indicates non-improved model fit).

Results

Demographic characteristics of the sample are the same as displayed in Table 4 in Chapter 3 (see Page 6 of the Tables document). As displayed in Table 13, 23.5% of the 1113 men reported that being tired does not decrease their sexual desire and an additional 43.8% reported that it only slightly decreases their sexual desire. As such, more than two-thirds (67.2%) experience no reduction, or only a slight reduction, in sexual desire as a result of being tired. Less than one-third (32.8%) of the men in the One Thousand Strong sample reported a substantial or complete reduction in desire, as only 27.5% reported that being tired would reduce
sexual desire “a lot” and 5.3% reported that it would do so “completely (i.e., I will not become aroused if I am tired).” Of the 261 men indicating that, 126 also reported that being tired can sometimes increase their sexual desire, as did a further 199 of the remaining men. Therefore, 460 men (41.3%) indicated that being tired does not uniformly reduce their desire.

As displayed in Table 14, a total of 325 men (29.2%) indicated that being tired can increase their sexual desire—and of these men, 126 had reported on the previous item that being tired does not reduce their sexual desire and 199 had reported that being tired can also reduce their sexual desire. These 325 men reporting that being tired can increase their sexual desire were, on average, younger. Looking at age ranges, 38.2% of GBM aged below 30 endorsed this statement, whereas only 22.8% of men aged 60 or older did so. Further, a marginally significant difference ($p = 0.06$) was observed regarding chronotype, as 34% of evening types endorsed this statement while only 25% of morning types did so. Endorsement of this statement did not differ according to usual sexual positioning identity.

In a multivariable context, binary logistic regression analyses showed that younger age predicted greater odds of reporting that being tired can increase sexual desire, even when adjusting for chronotype, which itself was not a significant predictor. The addition of chronotype in the second step of this model did not improve model fit. Results of these analyses are displayed in Table 15.

As displayed in Table 16, more than one-quarter (26.0%) of the 1113 men reported that being tired would make them more likely to be the receptive partner or “bottom” in anal sex. This was more commonly reported by younger GBM, as more than one-third (33.5%) of men aged below 30 endorsed this option compared to 21.3% of men aged 60 or older. No differences were observed according to chronotype. However, substantial differences emerged depending on
men’s sexual positioning identity. For example, a greater proportion of those reporting a versatile positioning identity (37.8%) indicated that being tired would make them more likely to bottom, compared to those who identify as the insertive partner or “the top” in anal sex (3.6%) and those who identify as a “versatile/top” (21.1%).

In a multivariable context, binary logistic regression analyses showed that younger age predicted a greater odds of endorsing the statement that “being tired would probably make me more likely to bottom” (compared to the other two options combined), when entered on its own in the first step of the analysis. When sexual positioning identity was entered in the second step of the analysis, it added substantially to the model fit indicators, as displayed in Table 17.

Discussion

Contrary to the assumption that being tired would result in decreased desire for sex, the current findings support Hypothesis 8 by showing that, for many of the GBM (23.5%) in the national One Thousand Strong cohort, being tired does not decrease their desire for sex. Indeed, more than two-thirds (67.2%) reported that being tired causes no reduction, or only a slight reduction, in sexual desire. Referring back to the conceptual model in Figure 1, these results suggest that Pathway A, which contends that tiredness suppresses the outcome via lethargy or inactivity, applies to only 32.8% of the men in our sample, as it relates to sexual desire.

Additionally, a total of 325 men (29.2%) reported that being tired can actually increase their sexual desire, providing support for Hypothesis 9. These men were, on average, younger (both in bivariate and multivariable analyses adjusting for chronotype), and included a greater proportion of evening types (though only marginally significant in bivariate analyses). These findings implicate tiredness in sustained levels of sexual desire and, for many GBM, increased levels of sexual desire, particularly among younger GBM. However, it should be noted that the
study’s questions did not explicitly ascertain whether this increased desire necessarily resulted in actual sexual activity and sexual risk-taking.

Further, the current findings also uncovered that a substantial proportion of men (26%) reported that being tired would make them more likely to adopt the receptive position in anal sex. This was more commonly reported by those identifying as versatile in their usual sexual positioning (37.8%) and by those aged under 30 (33.5%). This finding is particularly important given that receptive positioning in anal sex represents greater risk for HIV infection and other STIs, relative to insertive positioning (CDC, 2012). The current finding that tiredness can situationally heighten one’s risk for HIV infection highlights the need for sexual health research to consider tiredness and sleep health as important factors in HIV prevention for GBM.

Chronotype did not emerge as a predictor of reporting that being tired increases one’s odds of receptive positioning when tired, and there was no reason to hypothesize that it would have an effect on this outcome. However, future studies could look at the match or mismatch in chronotype between two male partners, and whether sex between a morning person and an evening person that occurs later in the day or night will be more likely to involve the partner with the morning chronotype adopting the receptive role, while sex occurring earlier in the day may be more likely to involve the morning person adopting the insertive role. The potential in male-to-male sex for each partner to switch positioning according to fluctuations in effort, energy, and alertness, with its ramifications for HIV and STI risk, is not a feature typically shared by heterosexual or female-to-female sexual contact. To my knowledge, no study has yet considered the role of chronotype on sex among GBM at different times of day. Future dyadic studies could build upon the current findings, both in relation to sexual health and relationship satisfaction.
Among the limitations of the current study is the fact that these questions asked about sexual desire and positioning behavior, but did not actually ask participants about implications for their condom use. Future studies could ask about condom use and explore whether GBM report that tiredness affects their attitudes and self-efficacy regarding condom use. The current study’s questions also did not ask about concurrent or antecedent substance use with sex when tired, or about whether participants were responding in relation to sex with main or casual partners. Future research should explore whether changes in positioning preferences apply equally to sexual situations with main versus casual partners. Limitations regarding the representativeness of the sample, as have been stated in Aims 2 and 4, similarly apply to the current findings, as does the observation that these survey findings warrant testing in daily diary or experimental studies.

In sum, this work has uncovered two previously unexplored factors that could be heightening risk for HIV and STI infection among GBM, and particularly younger GBM: that tiredness does not uniformly dampen sexual desire, and that tiredness can also increase one’s preference for adopting the receptive positioning in anal sex (representing the higher risk position for HIV infection and various STIs). This builds onto the findings of Aim 4 that anal sex with casual male partners commonly occurs at night and after midnight for many GBM—even for a substantial proportion of morning types—which suggests that sex might be frequently occurring in the context of late-night tiredness. The finding that tiredness may not diminish sexual desire, yet does diminish self-regulatory capacity and decision-making (as shown in the sleep science literature), thus underscores the importance of considering tiredness in the sex lives of GBM.
CHAPTER SEVEN

Aim 6: Day-level Associations Between Sleep Quality and Subsequent Sexual Behavior

In order to gather evidence on whether previous night’s sleep quality predicts same-day sexual engagement (and sexual activity with a male partner) and sexual risk-taking (anal sex without condoms involving the risk of HIV transmission), data were analyzed from the day2day daily diary study. In addition to questions previously described in Chapter 4, a range of questions regarding sexual behavior were asked in the daily diary assessments in the day2day study. As stated in the Introduction, the goal of this aim was to test the following two hypotheses. Firstly, that previous night’s sleep quality reported in the afternoon will not be associated with the odds of subsequent sexual engagement (i.e., having any sexual activity vs. none) (Hypothesis 10). Secondly, it was hypothesized that poorer previous night’s sleep quality will be associated with increased odds of engagement in CAS (i.e., having CAS vs. non-CAS sexual activity) (Hypothesis 11).

Method

Participants and Procedure

Details are as stated in Chapter 4.

Measures

As described in Chapter 4, the following variables were used as predictors:

Within-person sleep quality. See Chapter 4.

Between-person sleep quality. See Chapter 4.

Age. See Chapter 4.

Day-level sexual behavior. Participants’ daily reports of whether they engaged in any sexual activity with a partner (whether main or casual) on the previous day were coded as a
dichotomous outcome where 0 = none and 1 = any sexual activity with a partner, lagged back to match the previous day’s report of sleep quality.

**Day-level sexual CAS.** Participants’ daily reports of whether they had CAS were coded as a trichotomous outcome, where 0 = no sexual engagement, 1 = any sexual activity that was not CAS, and 2 = sexual CAS, also lagged back to match the previous day’s report of sleep quality.

**Analytic Plan**

Similar to the analytic plan set out in Chapter 4, multilevel modeling was employed to test whether an individual’s day-to-day fluctuations in previous night’s sleep quality—as a Level 1 predictor—would be associated with increased odds of sexual engagement and sexual risk-taking on a given day. That is, worse-than-usual previous night’s sleep quality would predict greater odds of engaging in any sexual activity (i.e., any sexual activity with a partner vs. none) in a binomial model (Model A), and separately with increased odds of engaging in CAS (i.e., CAS vs. sexual activity that did not involve CAS on a day of sexual activity) within a multinomial model (Model B).

These models were run as logistic multilevel models, with day as a repeated measures variable and participant ID as the grouping variable. Prior to MLM analyses, a bar plot was created to visually inspect whether there was variability between individuals in their average odds of sexual engagement and of CAS. In line with the recommendations of Rendina et al. (2016), both models adjusted for the effect of time across the daily diary reporting period (i.e., the day centered at Day 11 of 21 days, with the earlier period of Days 1 to 11 as the referent category) and for the effect of weekend days of reporting (Friday, Saturday, and Sunday vs. all other days as the referent category). In order to account for the stronger correlation between days
that are closer to each other than days set further apart, the covariance matrix structure was
specified as first-order autoregressive, or AR(1). In sum, both models adjusted for the effects of
age (centered) and average sleep quality (person-centered)—as Level 2 predictors—and day of
reporting, and whether it was a weekend or weekday—as Level 1 predictors.

Similar to Chapter 6, sexual risk was operationalized as CAS with a male partner but
could include both main and casual partners, regardless of the partner’s HIV status, in order to
include risk for STI transmission and to avoid the question of whether the participant knew of, or
assumed, the HIV or PrEP status of their partner.

Results

As outlined in Chapter 4, the day2day sample consisted of 52 HIV-positive GBM
recruited from the New York City area. On average, the men were 38.7 years old (SD = 10.2),
ranging from 22 to 67 years in age. The majority of the sample reported being single (73.1%), of
a racial/ethnic minority (68.8%), and earning less than $30,000 annually (59.6%). All men were
currently prescribed antiretroviral (ART) medications, and 80.8% reported that their most recent
viral load test showed an undetectable viral load. Demographic details are summarized in Table
7. These 52 participants completed between two and 21 of their afternoon diary entries per day
for a total of 803 reports, from a possible maximum of 1,092 entries, as displayed in Figure 5.
This represents an average of 15.4 days per participant. However, only 642 days had entries
completed on the next day from which sex reports could be lagged back or matched. As SPSS
Version 24.0 utilizes pseudo maximum likelihood estimation for multilevel models using
categorical outcomes, missingness was not estimated. Participants’ daily afternoon ratings of last
night’s sleep quality generated a mean sleep quality of 3.05 (SD = 0.85), on the scale of 0 to 5,
where these means among individuals ranged from a mean sleep quality of 0.77 to 4.71.
Odds of engagement in any sexual activity (vs. having no sexual activity)

Figure 9 displays the variability in participants’ odds of reporting days of having any sexual engagement. Some participants indicated odds of sex ranging from 0.0 (indicating no days of sex reported) to 1.0 (indicating having sex on 100% of days reported). There were 135 reports of days of sex out of a possible 642 valid reports, and accordingly the odds of sex on a given day, without accounting for nesting within individuals, was $135/507 = 0.27$.

For the investigation of previous night’s sleep quality on engagement in any sexual engagement, the model (Model A) contained the fixed effects of between- and within-person sleep quality, and the random effect of the intercept and within-person sleep quality, adjusting for age (centered) as a Level 2 predictor, and the effect of days across the diary period (centered at Day 11), and of the given day being a weekend (ref. Monday-Thursday), as Level 1 predictors. As displayed in Table 18, the results show a non-significant adjusted odds ratio for within-person sleep quality of 0.99 ($p < 0.95$), indicating that day-to-day fluctuations in sleep quality have no day-level association with the odds of engaging in sexual activity on a given day.

Odds of engagement in CAS (vs. non-CAS sexual activity)

Figure 10 displays the variability in participants’ odds of reporting days of having CAS. Some participants’ indicated odds of CAS ranging from 0.0 (indicating no days of CAS reported) to 0.45 (indicating having CAS on 31% of days reported). There were 78 reports of days of CAS out of a possible 642 valid reports, and accordingly the odds of CAS on a given day, without accounting for nesting within individuals, was $78/564 = 0.14$. However, these 78 events of CAS of the total 135 sex days represent odds of CAS on a day of having any sex, without accounting for nesting within individuals, of $78/57 = 1.67$. 

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For the investigation of previous night’s sleep quality on the odds of engaging in CAS (vs. non-CAS sexual activity), the model (Model B) contained the fixed effects of between- and within-person sleep quality, and the random effect of the intercept and within-person sleep quality, adjusting for age (centered) as a Level 2 predictor, and the effect of days across the diary period (centered at Day 11), and of the given day being a weekend (ref. Monday-Thursday), as Level 1 predictors. As displayed in Table 18, Model B resulted in a non-significant adjusted odds ratio for within-person sleep quality of 1.03 ($p = 0.88$), indicating that day-to-day fluctuations in sleep quality have no day-level association with the odds of engaging in CAS (vs. non-CAS sexual activity) on a sex day.

**Discussion**

The current analyses, which aimed to test day-level associations between previous night’s sleep quality and subsequent engagement in any sex and in CAS, did not find significant associations with either outcome, among a sample of 52 HIV-positive GBM based in New York City. Thus, Hypotheses 10 and 11 were not supported. The almost-zero association between previous night’s sleep quality and the odds of engaging in any sexual activity with a partner on a given day is indication that worse-than-usual sleep quality from the previous night does not diminish the odds of subsequent sexual activity. In other words, sexual activity on a given day is not consistently dampened or impeded by worse-than-usual sleep quality the night before. Further, person-level sleep quality was not associated with either outcome.

The second set of analyses found that the odds of engaging in CAS (vs. non-CAS sexual activity) were also not significantly associated with previous night’s sleep quality. In other words, worse-than-usual sleep quality the night before neither impeded nor increased sexual risk-taking compared to non-CAS sexual activity on a given day. However, it should be noted that the
adjusted odds ratio, though non-significant, was positive in direction, indicating that perhaps worse-than-usual sleep quality was negatively associated with the odds of engaging in CAS relative to other sexual activities not involving CAS. This may be in part due to the fact that the latter could involve less effortful, time-consuming, or logistically demanding activities such as oral sex or other forms of non-penetrative sex.

These findings are important firstly as they do not support the assumption that being tired would necessarily dampen one’s engagement in the active behavior of sexual contact with a partner—indeed, many of the GBM in this small sample reported that they still do engage in sexual activity even though they may have slept worse than usual. Secondly, while these findings did not show poor sleep quality increasing the odds of sexual risk-taking relative to non-CAS sexual activity, they do provide evidence that many GBM may be making sexual safety decisions under the impairing effects of tiredness.

Some of the limitations of the current study include the relatively small number of CAS days out of the total number of diary days reported with which to detect an association. As noted in Chapter 4, many reported days were followed by missing reports on the next day, which meant that the behavioral outcome could not be matched back to the previous day, thus preventing inclusion in these analyses. Furthermore, these analyses did not explore whether sleep quality was associated with odds of substance use combined with or preceding sex. Sexual risk was operationalized to include any CAS regardless of partner’s HIV or PrEP status, the participant’s detectability status, and whether the partner was a main or casual partner. Therefore the risk represented by CAS was not strictly risk for HIV transmission, but did represent risk for STI transmission. Also as noted in Chapter 4, the current sample of 52 HIV-positive men living in
New York City was predominantly of a racial/ethnic minority, mostly of undetectable HIV status, and of low income and education level.

Future research should explore associations among other samples, and could also explore whether an indirect pathway exists whereby poor sleep quality leads to greater emotion dysregulation which then also leads to increased desire for intimacy or pleasure, potentially as a means of mood-repair. Future research should also consider whether consecutive nights of poor sleep quality have a more pronounced effect on subsequent sexual decision-making. Other factors—such as sexual positioning, chronotype, and lifestyle (e.g., being a shiftworker)—should also be explored.
CHAPTER EIGHT  
General Discussion

On a regular basis, more than one-third of U.S. adults do not receive sufficient sleep (CDC, 2011), and resulting tiredness is implicated in a range of adverse health outcomes such that insufficient sleep has been declared a “public health epidemic” (CDC, 2012). Given that tiredness is a widespread and common experience for many, the current dissertation sought to explore some of the effects of tiredness in relation to alcohol use and sexual behavior among gay and bisexual men. Taken together, the findings in the preceding chapters have contributed meaningfully to our understanding of the “when” and the “why” involved in alcohol use and sexual behavior among GBM. Situating this within the framework of dual processes in self-regulation (e.g., Metcalfe & Mischel, 1999), it is argued that tiredness situationally compromises self-regulatory success by impairing the cognitive, rational, higher-order capacities involved in cool processing and, in part, by exacerbating the desires or urges that fuel more affective-laden hot processing. The following sections will briefly summarize the findings in relation to each behavior in turn, before then exploring the implications of these findings for future research and for intervention development.

Tiredness and Alcohol Use  

Firstly, it was shown that the drinking of alcohol happens most commonly at night for GBM, particularly for younger GBM and for those with a later chronotype. The findings of Aim 1 also showed that, for a substantial proportion of those with a morning chronotype, drinking still occurs at a time of day when they are presumably tired or in their circadian off-time. In Aim 2, it was shown that a majority of alcohol-using GBM reported that they sometimes use alcohol (whether with or without energy drinks) in order to help them stay awake longer on nights when...
they are out socializing. Using alcohol to help stay awake was also more common among younger GBM—indeed, it was reported by more than two-thirds (67.1%) of the GBM under 30—and this is of concern given higher rates of alcohol use among younger GBM (Graham et al., 2011; Marshal et al., 2009). Also more common among younger GBM was the use of alcohol mixed with energy drinks which has, in the energy drink literature, been linked with numerous negative health consequences including injury, condomless sex, and hospital admissions (McKetin et al., 2015; Snipes & Benotsch, 2013; Wells et al., 2013). The findings of Aim 2 suggest that the experience of being tired and the wish to stay awake longer constitute a commonly-held motivating factor amongst many GBM that increases their alcohol use. In Aim 3, a day-level association between poor sleep quality and next-day drinking did not reach significance among a sample of 52 HIV-positive GBM. Though a null finding, this does indicate that being tired from poor sleep does not necessarily or consistently stop GBM from engaging in alcohol use—and that therefore, a considerable proportion of drinking occasions may occur when tired. Future research is needed to explore this further.

These findings each relate back to aspects of the conceptual model in Figure 1 proposed in Chapter 1. Findings that alcohol use commonly occurs late at night, even for many morning types, indicate that Pathway A, whereby tiredness increases lethargy which should lower the odds of engaging in the behavior, is not uniformly shared by all of the GBM we surveyed. Additionally, poor sleep quality was not shown to uniformly impede subsequent drinking (as was shown in Aim 3). Furthermore, the finding that many men reported using alcohol to help them combat tiredness (as shown in Aim 2) provide support for Pathway C in Figure 1, whereby tiredness increases motivation to engage in the behavior and thus raises the odds that it will occur. However, these analyses do not comprehensively test all aspects of the conceptual model,
as it cannot be established here whether the null findings in Aim 3 reflect the cancelling out of Pathways B and C by Pathway A (i.e., dampened energy that lowers odds of engaging in drinking). In other words, perhaps impaired self-regulation did increase the chances that participants would engage in heavy drinking (Pathway B), but its effect was buffered or cancelled out by the suppressive effect of lethargy and inactivity in the top pathway. The current study designs were unable to verify this, however.

This work is the first to suggest that tiredness could motivate general alcohol use (separate from the energy drink literature), and that sleep health interventions could help to better prepare GBM with greater alertness, cognitive functioning, and emotion regulation while making their alcohol use decisions. This applies a wealth of sleep science research to our understanding of alcohol use, as tiredness or sleep-related fatigue can be expected to reduce an individual’s self-regulatory capacity via its impairing effects on executive functioning, emotion regulation, and motivation (see Womack et al., 2013 for a review). The more innovative or novel contribution of the current findings however, is that tiredness might simultaneously be motivating or promoting alcohol use as individuals attempt to combat their fatigue, to the further detriment of their alertness and decision-making processes. In essence, this work has uncovered the possibility that, at times, individuals drink because they are tired and, because they are tired, they might then drink more. The harmful spiral continues as the subsequent drinking then contributes to the individual feeling even more tired once the sedative effects of alcohol set in. Evidently, this spiral suggests a complex and entangled dynamic between tiredness and alcohol use among GBM. While challenging on a study design level, this highlights the need for future research with appropriately complex time-sensitive methodologies to further elucidate these complex dynamics.
These findings also add to previous research which has explored enhancement motives for drinking alcohol. For example, in a scale by Cooper and colleagues (1992), the enhancement motives for drinking include “to get high,” “because it’s exciting,” “because it’s fun,” “because you like the feeling,” and “because it makes you feel good.” The current findings indicate that a related, though distinct, motive of people’s alcohol use is to help one stay awake longer when out socializing but feeling tired. Recent research on expectancies related to alcohol mixed with energy drinks has identified that combatting fatigue and staying active for longer periods of time while drinking are motivating factors among people who drink alcohol with energy drinks (MacKillop et al., 2012; Miller et al., 2017). Our research, however, indicates that these motivations may also be relevant for alcohol use even when energy drinks are not involved, which was reported by 153 of the 927 GBM as shown in Aim 2. It is thus argued that this motivation for alcohol use should be added to, and considered alongside, the various other drinking motives that have been included in drinking motives scales (e.g., Cooper et al., 1992) and substance use expectancies scales (e.g., Brown, Christiansen, & Goldman, 1987).

In sum, the three Aims described in Chapters 2-4 have generated findings that have advanced our understanding of some of the contexts (i.e., mostly nighttime) and motives (e.g., combatting tiredness) involved in the drinking behaviors of GBM. The findings also suggest the need for future daily diary studies on alcohol use to gather detail on time of day when drinking begins and on levels of concomitant tiredness and/or antecedent sleep quality. Exploring the temporal patterns of drinking among GBM, as well as a focus on differing motives for drinking at different times, could be informative for identifying risk factors in such behaviors and for developing interventions to improve the ability of GBM to manage their alcohol use and associated behaviors.
Tiredness and Sexual Behavior

In relation to sex, the findings of Aim 4 uncovered rich contextual information for when GBM have anal sex with casual partners. Firstly, it was shown that two-thirds of all recent anal sex events (whether without or with condoms) were reported to have occurred at night, and frequently late at night, in our national sample of GBM. Later times for sex with casual partners were more commonly reported by younger GBM and by those reporting an evening chronotype. However, a substantial number of men with a morning chronotype reported that their most recent event had occurred late at night, when morning types can generally be expected to be experiencing substantial levels of tiredness. To my knowledge, this is the first attempt to gather data on when GBM have sex with casual male partners, and is also the first study about timing of sex to differentiate between sex with and without condoms. These findings are important given what is known from the sleep science literature about the impairing effects of continued wakefulness (particularly from approximately 14 hours of continued wakefulness onwards) on cognition, emotion, and decision-making (see Womack et al., 2013 for review).

These findings are important also when considered alongside the findings of Aim 5—that, for many GBM, tiredness does not substantially dampen or impede their desire for sex and can actually increase desire levels, again particularly among younger GBM. Furthermore, a sizeable proportion of GBM indicated that tiredness would increase their odds of being the receptive partner in anal sex, particularly among younger GBM and among those reporting a versatile sexual positioning identity. In other words, many GBM reported being more likely to engage in riskier sexual positioning when they are tired, at the same time that tiredness may be simultaneously increasing their desire for sex. This may be coinciding with the impairing effects of tiredness on cognition, emotion, and decision-making, as have been shown in the sleep...
science field. Additionally, the almost-zero day-level association found between sleep quality
and subsequent engagement in any sexual activity with a partner in Aim 6 further supports the
contention that sex among GBM can and does occur despite worse-than-usual sleep quality.

These findings provide strong evidence that anal sex with casual male partners is, for
most GBM, a nighttime activity and one which can occur while the individual is under the
impairing influence of tiredness. These findings each relate back to aspects of the conceptual
model in Figure 1. Findings that sex commonly occurs late at night and later than one’s usual
time for becoming tired indicate that Pathway A, whereby tiredness increases lethargy which
should lower the odds of engaging in the behavior, is not uniformly shared by all of the GBM we
surveyed. Indeed, the responses of a substantial proportion of participants suggest that Pathway
A does not apply to them in terms of their felt levels of sexual desire, by reporting that being
tired does not reduce their sexual desire. Additionally, poor sleep quality was not shown to
uniformly impede subsequent sexual engagement (as shown in Aim 6). Furthermore, the finding
that many men reported that tiredness can actually increase their desire (as shown in Aim 5)
provide support for the Pathway C in Figure 1, whereby tiredness increases motivation to engage
in the behavior and thus raises the odds that it will occur. Tiredness was also reported by many to
increase their preference for being the receptive partner in anal sex, further increasing risk for
HIV and several STIs (CDC, 2012).

While the analyses did not explicitly address the Pathway B in Figure 1, whereby
tiredness impairs self-regulation and thus raises the odds of sexual risk-taking, the issue was
partly explored in Aim 4. It was observed that a slightly greater percentage of recent CAS events
were reported to have occurred after midnight compared to events involving sex with condoms.
Future research could ask men more directly about whether and how their sense of self-efficacy
regarding condom use or their ability self-regulate or exercise self-control in a sexual situation might be influenced by tiredness.

In sum, Aims 4-6 have generated findings that advance our understanding of some of the contexts (i.e., mostly nighttime) and motivators (e.g., increased desire, increased odds of receptive positioning) involved in the sexual behaviors of many GBM. These findings are among the first to connect two aspects of the human experience that are not typically considered together: tiredness and sex. As mentioned, I am aware of only one study that has explored cross-sectional associations between overall sleep quality and sex-related outcomes in GBM (Duncan et al., 2016), in which both poorer global sleep quality and shorter sleep duration were positively associated with reporting receptive anal sex with a greater number of recent partners—and notably, the association was stronger for receptive CAS, which concurs with the findings of Aim 5. The current findings extend this work by asking GBM directly about the influence of tiredness on sexual desire and sexual positioning, and also by exploring event-level associations between sleep quality and sexual engagement and CAS. As explained in Chapter 1, the only other studies looking at sleep and sex, of which I am aware, have focused on heterosexual samples and have instead identified links between poor sleep and reduced sexual functioning (Allen & Desille, 2017; Budweiser et al., 2009; Chen et al., 2016; Kalmbach et al. 2015; Kling et al., 2017; Lin et al., 2015) or on sleep disorders and abnormal behavior (Schenck et al., 2007). The current findings also highlight the need for future daily diary studies on sex among GBM (as well as other populations) to gather details on time of day when sexual activity begins and on levels of concomitant tiredness and/or antecedent sleep quality.
Implications for Future Research and Intervention Development

The findings of Aims 1 and 2 raise an important implication for future laboratory-based studies of alcohol use and its effects on cognition, emotion, physiology (e.g., sexual arousal), decision-making, and/or behavior: that, in order to maximize ecological validity and a task’s resemblance to the real-world contingencies of the typical drinking practices among GBM, particularly for younger GBM, lab-based studies should ideally be conducted at night or when participants are similarly fatigued, rather than in the bright, clear light of day during typical 9-5pm lab hours. It is anticipated that the impairing effects of alcohol intoxication and phenomena such as alcohol myopia (Steele & Josephs, 1990) and other alcohol-related biases and sequelae, may be amplified at night, and may better match the real-world conditions in which drinking behaviors typically occur. For similar reasons, the findings of Aims 4 and 5 suggest that experimental research on sexual response and decision-making (e.g., the effects of arousal on outcomes) should also be conducted at times of day or in states of tiredness that more closely match the real-world conditions in which sexual decisions are typically made.

An additional recommendation for alcohol research is that studies need to incorporate a greater appreciation of the stimulatory effects of alcohol that emerge prior to the later, more commonly-known sedatory effects (Hendler et al., 2013), as well as the fact that alcohol is often combined with glucose-rich mixers (e.g., sodas, juices), caffeinated products (e.g., cola, coffee), or energy drinks (e.g., Red Bull). Research also needs to explore how people may be using alcohol and/or its accompaniments for their energizing, stimulatory effects—especially younger people as they tend to have less well-regulated sleeping patterns and may engage in late-night social activities more often than do older adults.
While poor sleep and actual sleep deprivation have been implicated in relapsed drinking among people trying to abstain from alcohol, the current findings indicate that being tired is also implicated in drinking behaviors in general. Accordingly, intervention efforts to increase people’s awareness of their sleep health and of the potential for tiredness to impair their decision-making regarding alcohol use could help to prevent progression to problematic drinking. This appears particularly relevant for younger adults and adolescents, as research indicates that patterns of problematic drinking begin to emerge early for many people (Craig, Morris, Piquero, & Farrington, 2015; Patrick & Schulenberg, 2014). Early interventions for younger adults and adolescents, via psychoeducation regarding sleep health and its benefits, could be particularly well-timed in a developmental sense at this vulnerable life-stage. This psychoeducation could be engagingly delivered in cost-effective, minimally laborious, and wide-reaching ways using internet and mobile technologies, almost as a blanket approach for all participants in a public health campaign.

However, it is also suggested that, for people with more problematic patterns of alcohol use or sexual behavior, more personalized intervention could be delivered in one-on-one counselling. Adding content on sleep health as a discrete module within existing counselling interventions—whether with a cognitive-behavioral therapy (CBT) approach, a mindfulness approach, or a motivational interviewing approach—could be especially beneficial for clients who indicate that tiredness is particularly debilitating and/or regularly prevalent in their daily lives. Within a CBT paradigm, therapists could engage clients in contingency planning to help them better prepare for behavior change in situations when tiredness is likely to occur, while within a mindfulness paradigm, therapists could challenge clients to utilize skills in bodily and mental awareness to better recognize when they are experiencing the effects of tiredness.
Furthermore, improvements in sleep health could help to reduce the impetus for people to consume alcohol mixed with energy drinks. This appears particularly important for the GBM community, given that GBM tend to report greater use of alcohol mixed with energy drinks compared to females and heterosexual males (Wells et al., 2013). Improvements in sleep health could also help to reduce the incidence of drinkers augmenting their drinking events with the use of stimulant drugs such as cocaine, methamphetamine, and prescription stimulants, to combat their tiredness.

Future research could also attempt to apply the questions in the current analyses to studies of drug use, both among GBM and other populations, as it is expected that drug use also most commonly occurs at night, and that tiredness may, for similar reasons, motivate their usage. As preliminary indication of this, additional items in the studies described in Aims 1 and 2 also asked GBM about their drug use. While only 14.1% of the sample in Aim 1 reported recent drug use, they did most commonly report drug use at night (90.8%), and while only 22.7% of the sample in Aim 2 reported recent drug use, a substantial proportion of these men reported the use of drugs to help them stay awake (34%). Future research is needed to expand upon these preliminary findings.

The implications of the findings relating to sex (Chapters 5-7) for HIV and STI prevention among GBM are also substantial. First, contrary to the assumption that tiredness would suppress or impede sexual desire and sexual activity, evidence has been provided in each of the Aims 4-6, albeit from different angles, that sex among GBM can still, and frequently does, occur in the context of tiredness. This includes the findings that: sex commonly occurs late at night and, for many, later than their usual or expected time of becoming tired (Aim 4); being tired can motivate sexual desire and can increase one’s odds of engaging in riskier sex in terms
of positioning (Aim 5); and previous night’s sleep quality does not lower the odds of engaging in sexual activity on a given day (Aim 6). While not a comprehensive test of the three different pathways, as depicted in the conceptual model in Figure 1, the current findings do suggest that Pathway A from tiredness to inactivity to lowered odds of behavioral engagement in sex is somewhat counter-balanced and/or nullified by either or both of the other pathways posited to raise the odds of behavioral engagement—one through impaired self-regulation and the other through the motivating effect of tiredness on sexual desire. In essence, this work has uncovered the possibility that, at times, individuals are more likely to have sex because they are tired and, because they are tired, they might be less self-efficacious in implementing sexual safety strategies. Further research should attempt to test these competing pathways simultaneously and more directly.

These findings have highlighted two risk-enhancing effects of tiredness that were found to be particularly pronounced among younger GBM—increased sexual desire and increased likelihood of receptive CAS—and the public health and sexual health implications of these findings are extensive. It is concerning that a substantial proportion of GBM reported being more likely to engage in riskier sexual positioning when they are tired at the same time that tiredness may be simultaneously increasing their desire for sex and impairing their capacity to regulate their emotions and employ sexual safety practices, such as condom use negotiation and verbal communication with partners about HIV and STI status. These implications are particularly important for younger GBM who tend to be at greater risk for HIV infection (CDC, 2016a) and poorer sleep health (Brown, Buboltz Jr, & Soper, 2002) than older GBM. Additionally, the findings of Aims 1 and 4 indicate that younger GBM are more likely to report later times of drinking alcohol and having sex with casual partners, while the findings of Aim 2 indicate that
younger GBM are also more likely to endorse use of alcohol to help them stay awake longer, which may further interact to impair self-regulation and utilization of sexual safety strategies if subsequent sexual activity is occurring under the combined influence of both tiredness and alcohol intoxication. Accordingly, future research should further explore connections between tiredness, sex, and the use of alcohol and drugs before and/or during sex when feeling tired.

This work provides compelling impetus for sexual health interventions to consider tiredness and sleep health as well as the question of whether a given individual commonly encounters sexual decision-making tasks when he is tired. For individuals who do commonly face the task of making sexual safety decisions when tired, such interventions would be particularly relevant and beneficial. The findings accord with recent health behavior models that have placed an emphasis on sleep health (Barber, 2010; Hagger, 2014), and extends these two models by also applying the issue of sleep and tiredness to health behaviors involving sex. The fact that risk of receptive CAS increases with tiredness more so among men who identify as versatile or as bottoms compared to tops, and among younger GBM, also highlights the need for interventions to be tailored with regard to relevant factors such as positioning identity and age.

It should be noted that the findings of Aim 5, on a sample of HIV-negative GBM, regarding tiredness and the increased odds of being the receptive partner in anal sex may have differing public health and HIV prevention implications in relation to HIV-positive GBM. For an HIV-positive GBM with a detectable viral load who also reports that being tired increases his odds of being the receptive partner, the outcome of CAS with an HIV-negative partner actually carries a reduced risk of HIV infection for the partner, as the HIV-positive partner may be less likely to be the insertive partner. That being tired may make many HIV-positive GBM more likely to be the receptive partner (which would be beneficial for lessening the risk of secondary
transmission of HIV, but is simultaneously detrimental for the HIV-positive GBM in terms of STI risk) speaks to the complexity of the implications of tiredness for sexual health. It could be argued that an intervention to improve sleep quality and lessen tiredness among HIV-positive GBM could, in effect, energize these men (including those with detectable viral loads) to engage in more instances of insertive anal sex—however, such interventions should simultaneously work to increase the individual’s self-awareness of how their tiredness is affecting their choices and decision-making, and may also target related outcomes such as viral suppression, overall health, emotion regulation, and substance use reduction. Increasing awareness in GBM of how tiredness may be affecting their sexual decision-making may help to increase their self-efficacy in managing their sexual behaviors. Sleep health interventions aimed at improving overall sleep quality would also be expected to produce improvements in various other realms such as physical and mental health (Okajima, Komada, & Inoue., 2011) that would also confer benefits.

Among the strengths and limitations of the current work, is the fact that the various analyses drew on three diverse samples of GBM—one consisting of men recruited online from sexual and social networking websites; another consisting of a national sample of HIV-negative GBM from across the USA enrolled in a larger, three-year longitudinal cohort study, and; finally, another consisting of HIV-positive GBM based in New York City participating in an intensive daily diary study. A strength of this work is that none of the three groups would have been primed to consider the role of tiredness in their behaviors by having received the questions in the other two datasets. A limitation of the current work is that several inconsistencies exist between the questions in the three studies. For example, chronotype was measured in Aim 1 by a single item and in Aims 2, 4, and 5 by the five-item MEQ-R scale, but was not measured in Aims 3 and 6. Additionally, Aims 1 and 3 did not ask about the use of energy drinks with alcohol which may
have produced valuable information. Furthermore, by virtue of these studies’ emphasis on GBM, the generalizability of their findings to other populations remains to be established by future work. Greater exploration could also be done regarding potential differences between urban and rural GBM in their drinking patterns, as well as the potential for moderating factors such as gay community attachment or involvement in various social scenes. It is possible that GBM who are more closely involved with their local gay community could be disproportionately exposed to late-night situations involving alcohol and/or sex—particularly in bigger cities where bars are generally more accessible, gay-friendly, and open later into the night.

Finally, future research could also explore indirect pathways from tiredness to actual behaviors via intervening variables such as emotion regulation (as depicted in Pathway B) and types of affect or experiences of minority stress (such as discrimination and stigma). Consistent with sleep science research on the impairing effects of poor sleep on emotion regulation, Millar, Parsons, and Rendina (2017) found that worse-than-usual sleep quality was associated with greater next-day emotion dysregulation (as measured by four adapted items from the Difficulties in Emotion Regulation scale; Gratz & Roemer, 2004) in the day2day sample. Future research could explore whether an indirect pathway exists whereby poor sleep quality leads to greater emotion dysregulation which then also leads to increased alcohol or drug use, potentially as a means of self-medicating or mood-repair, or to engage in sexual contact. Sleep-health interventions could also aim to help GBM to better manage or regulate their emotions when they are tired, to prevent or lessen the likelihood of increased alcohol use. Future research could also consider whether consecutive nights of poor sleep quality have a more pronounced effect on subsequent alcohol use. Other potentially relevant factors such as chronotype and lifestyle (e.g., being a shiftworker) should also be explored or accounted for.
Conclusion

The current work has provided evidence that tiredness can situationally heighten risk-taking in both alcohol use and sexual behavior among GBM. A relatively consistent theme throughout the current findings is that younger GBM tend to report later times for these two risk behaviors, whether in part because they are also more likely to be evening types and are thus more commonly active later than morning types, or independently of chronotype. This suggests that, as men grow older, they may become better at managing their lifestyles in a less risk-prone way, or at least at preventing or coping with the effects of tiredness by maintaining comparatively better sleep health, although this cannot be confirmed by the current findings. This aligns with research that emotion regulation improves with increasing age (Mather & Carstensen, 2005). If GBM do tend to get better at managing their sleep, energy, and tiredness levels as they grow older, then perhaps interventions could aim to speed up this improvement so that younger men become better at managing these factors sooner in their development. These interventions seem particularly important given the health disparities faced by younger GBM (CDC, 2016a; Marshal et al., 2009).

Of course, it should also be noted that the results in Aims 1 and 4 show that not all events of drinking or sex occurred at night, just as the results in Aims 3 and 6 show that not all events of drinking or sex occurred after a night of worse-than-usual sleep quality. Additionally, the results in Aim 2 show that many GBM do not use alcohol to help them stay awake, while Aim 5 shows that, for many GBM, tiredness does in fact reduce their level of sexual desire and/or does not make them more likely to be the receptive partner in anal sex. These findings are not antithetical to the larger purpose of this dissertation, as it was not posited that tiredness, as but one factor among various factors potentially involved in risk-taking, would be relevant for all
participants—nor that its effects would be uniform or universal. The current work has, instead, advanced our understanding of tiredness, as one factor among numerous factors, that could be increasing health risks for many, though not all, GBM.

The heterogeneity in the current findings reflects the larger point that we should indeed expect heterogeneity among samples of GBM. For some men, tiredness may be relevant while it may not be so for others. This also speaks to heterogeneity within the individual too—that for an individual GBM, on some occasions, CAS might occur because he is tired, while on other occasions, it might occur because of intoxication or negative mood or internalized homonegativity or because of partner demands. Similarly, heavy drinking may occur, on some occasions, because he is tired, but on other occasions because he is upset, celebrating, lonely, or feeling particularly stigmatized. Helping GBM to more accurately identify how they are feeling prior to engaging in drinking or sex (including whether their tiredness may be affecting their emotions and decisions), may help them to more effectively utilize appropriate in-the-moment strategies to better deal with their current state.

Excitingly, future research and intervention development could also explore the role of tiredness in other health behaviors, whether for GBM specifically or other populations more generally. These other behaviors may include medication adherence (whether for HIV or PrEP or for non-HIV related conditions), drug use, efforts to quit or reduce smoking, and eating habits. Research on the role of tiredness in helping or hindering self-regulation in these behaviors may inform efforts to improve health more generally. Working towards the development of tailored interventions that aim to address relevant, though fluctuating, factors for the individual is an exciting endeavor in the fields of alcohol use and sexual health, and potentially other areas. It is
argued that, based on the evidence presented in this dissertation, such work should include adequate attention to the role of tiredness.
APPENDIX

5-Item Chronotype Scale


1. “Considering only your own ‘feeling best’ rhythm, at what time would you get up if you were entirely free to plan your day?”
   [5] 5:00 AM–6:30 AM (05:00–06:30 h)
   [4] 6:30 AM–7:45 AM (06:30–07:45 h)
   [3] 7:45 AM–9:45 AM (07:45–09:45 h)
   [2] 9:45 AM–11:00 AM (09:45–11:00 h)
   [1] 11:00 AM–12 noon (11:00–12:00 h)

2. During the first half hour after you wake up in the morning, how tired do you feel?
   [1] Very tired
   [2] Fairly tired
   [3] Fairly refreshed
   [4] Very refreshed

3. At approximately what time in the evening do you feel tired, and, as a result, in need of sleep?
   [5] 8:00 PM–9:00 PM (20:00–21:00 h)
   [4] 9:00 PM–10:15 PM (21:00–22:15 h)
   [3] 10:15 PM–12:45 AM (22:15–00:45 h)
   [2] 12:45 AM–2:00 AM (00:45–02:00 h)
   [1] 2:00 AM–3:00 AM (02:00–03:00 h)

4. At approximately what time of day do you think that you reach your ‘feeling best’ peak?”
   [5] 5–8 AM (05:00–08:00 h)
   [4] 8–10 AM (08:00–10:00 h)
   [3] 10 AM–5 PM (10:00–17:00 h)
   [2] 5–10 PM (17:00–22:00 h)
   [1] 10 PM–5 AM (22:00–05:00 h)

5. One hears about “morning types” and “evening types.” Which one of these types do you consider yourself to be?
   [6] Definitely a morning type
   [4] Rather more a morning type than an evening type
   [2] Rather more an evening type than a morning type
   [0] Definitely an evening type

   Added response option in Aim 1 only: Neither one – my levels of alertness and energy do not really change throughout the day
Table 1

Demographics of the Online Health Study Sample and Comparisons for the Analytic Sample

<table>
<thead>
<tr>
<th>Demographics</th>
<th>Total</th>
<th>Alcohol Use</th>
<th>No Alcohol</th>
<th>Test Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n (%)</td>
<td>n (%)</td>
<td>n (%)</td>
<td></td>
</tr>
<tr>
<td>Overall</td>
<td>3696 (100)</td>
<td>2814 (100)</td>
<td>882 (100)</td>
<td></td>
</tr>
<tr>
<td>Race and Ethnicity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black</td>
<td>337 (9.1)</td>
<td>254 (9.0)</td>
<td>83 (9.4)</td>
<td>( \chi^2(3) = 0.33 )</td>
</tr>
<tr>
<td>Latino</td>
<td>673 (18.2)</td>
<td>509 (18.1)</td>
<td>164 (18.6)</td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>2313 (62.6)</td>
<td>1768 (62.8)</td>
<td>545 (61.8)</td>
<td></td>
</tr>
<tr>
<td>Multiracial/Other</td>
<td>373 (10.1)</td>
<td>283 (10.1)</td>
<td>90 (10.2)</td>
<td></td>
</tr>
<tr>
<td>Sexual Identity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gay</td>
<td>3026 (81.9)</td>
<td>2315 (82.3)</td>
<td>711 (80.6)</td>
<td>( \chi^2(1) = 1.24 )</td>
</tr>
<tr>
<td>Bisexual</td>
<td>670 (18.1)</td>
<td>499 (17.7)</td>
<td>171 (19.4)</td>
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</tr>
<tr>
<td>Relationship Status</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single</td>
<td>2342 (63.4)</td>
<td>1756 (62.4)</td>
<td>586 (66.4)</td>
<td>( \chi^2(1) = 4.72^* )</td>
</tr>
<tr>
<td>Partnered</td>
<td>1354 (36.6)</td>
<td>1058 (37.6)</td>
<td>296 (33.6)</td>
<td></td>
</tr>
<tr>
<td>HIV Status</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative/Unknown</td>
<td>3040 (82.3)</td>
<td>2351 (83.5)</td>
<td>689 (78.1)</td>
<td>( \chi^2(1) = 13.56^{***} )</td>
</tr>
<tr>
<td>Positive</td>
<td>656 (17.7)</td>
<td>463 (16.5)</td>
<td>193 (21.9)</td>
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</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High school/GED/less</td>
<td>565 (15.3)</td>
<td>377 (13.4)^a</td>
<td>188 (21.3)^b</td>
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</tr>
<tr>
<td>Some college</td>
<td>1435 (38.8)</td>
<td>1074 (38.2)</td>
<td>361 (40.9)</td>
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<tr>
<td>4-year college degree</td>
<td>994 (26.9)</td>
<td>813 (28.9)^a</td>
<td>181 (20.5)^b</td>
<td>( \chi^2(3) = 48.24^{***} )</td>
</tr>
<tr>
<td>Graduate degree</td>
<td>702 (19.0)</td>
<td>550 (19.5)</td>
<td>152 (17.2)</td>
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</tr>
<tr>
<td>Recruitment Source</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hookup App</td>
<td>1885 (51.0)</td>
<td>1550 (55.1)^a</td>
<td>335 (38.0)^b</td>
<td></td>
</tr>
<tr>
<td>Hookup Site</td>
<td>909 (24.6)</td>
<td>614 (21.8)^a</td>
<td>295 (33.4)^b</td>
<td>( \chi^2(3) = 84.23^{***} )</td>
</tr>
<tr>
<td>Porn Sites</td>
<td>448 (12.1)</td>
<td>318 (11.3)^a</td>
<td>130 (14.7)^b</td>
<td></td>
</tr>
<tr>
<td>Facebook</td>
<td>454 (12.3)</td>
<td>332 (11.8)</td>
<td>122 (13.8)</td>
<td></td>
</tr>
<tr>
<td>Chronotype</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Morning Type</td>
<td>1103 (29.8)</td>
<td>794 (28.2)^a</td>
<td>309 (35.0)^b</td>
<td></td>
</tr>
<tr>
<td>Neither Type</td>
<td>617 (16.7)</td>
<td>422 (15.0)^a</td>
<td>195 (22.1)^b</td>
<td>( \chi^2(2) = 55.18^{***} )</td>
</tr>
<tr>
<td>Evening Type</td>
<td>1976 (53.5)</td>
<td>1598 (56.8)^a</td>
<td>378 (42.9)^b</td>
<td></td>
</tr>
</tbody>
</table>

\[
\begin{array}{ccc}
M (SD) & M (SD) & M (SD) \\
38.9 (13.7) & 37.7 (13.3) & 42.6 (14.2) \\
\end{array}
\]

Note. Within rows, cells with different superscripts differ significantly. Superscripts are not included where follow-up comparisons are not required. *\( p < 0.05 \). **\( p \leq 0.01 \). ***\( p \leq 0.001 \).
Table 2

*Bivariate Comparisons of GBM Reporting Peak Drinking During Day/Evening vs. 9pm Onwards, N = 2814*

<table>
<thead>
<tr>
<th></th>
<th>Day/Evening</th>
<th>From 9pm onwards</th>
<th>Total</th>
<th>Test Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n (%)</td>
<td>n (%)</td>
<td>n</td>
<td></td>
</tr>
<tr>
<td>Overall</td>
<td>1370 (48.7)</td>
<td>1444 (51.3)</td>
<td>2814</td>
<td></td>
</tr>
<tr>
<td>Chronotype</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Morning Type</td>
<td>530 (66.8)</td>
<td>264 (33.2)</td>
<td>794a</td>
<td>$\chi^2(2) = 156.40^{***}$</td>
</tr>
<tr>
<td>Neither Type</td>
<td>207 (49.1)</td>
<td>215 (50.9)</td>
<td>422b</td>
<td></td>
</tr>
<tr>
<td>Evening Type</td>
<td>633 (39.6)</td>
<td>965 (60.4)</td>
<td>1598c</td>
<td></td>
</tr>
<tr>
<td>HIV Status</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative/Unknown</td>
<td>1132 (48.1)</td>
<td>1219 (51.9)</td>
<td>2351</td>
<td>$\chi^2(1) = 1.64$</td>
</tr>
<tr>
<td>Positive</td>
<td>238 (51.4)</td>
<td>225 (48.6)</td>
<td>463</td>
<td></td>
</tr>
<tr>
<td>Recruitment Source</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hookup App</td>
<td>650 (41.9)</td>
<td>900 (58.1)</td>
<td>1550a</td>
<td></td>
</tr>
<tr>
<td>Hookup Site</td>
<td>375 (61.1)</td>
<td>239 (38.9)</td>
<td>614b</td>
<td>$\chi^2(3) = 84.29^{***}$</td>
</tr>
<tr>
<td>Porn Sites</td>
<td>192 (60.4)</td>
<td>126 (39.6)</td>
<td>318b</td>
<td></td>
</tr>
<tr>
<td>Facebook</td>
<td>153 (46.1)</td>
<td>179 (53.9)</td>
<td>332a</td>
<td></td>
</tr>
<tr>
<td>Race and Ethnicity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black</td>
<td>99 (39.0)</td>
<td>155 (61.0)</td>
<td>254a</td>
<td></td>
</tr>
<tr>
<td>Latino</td>
<td>174 (34.2)</td>
<td>335 (65.8)</td>
<td>509a</td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>984 (55.7)</td>
<td>784 (44.3)</td>
<td>1768b</td>
<td>$\chi^2(3) = 95.50^{***}$</td>
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<tr>
<td>Other</td>
<td>113 (39.9)</td>
<td>170 (60.1)</td>
<td>283a</td>
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</tr>
<tr>
<td>Relationship Status</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single</td>
<td>778 (44.3)</td>
<td>978 (55.7)</td>
<td>1756</td>
<td>$\chi^2(1) = 35.86^{***}$</td>
</tr>
<tr>
<td>Partnered</td>
<td>592 (56.0)</td>
<td>466 (44.0)</td>
<td>1058</td>
<td></td>
</tr>
<tr>
<td></td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
<td></td>
</tr>
<tr>
<td>Age (years)</td>
<td>41.9 (13.8)</td>
<td>33.8 (11.6)</td>
<td>37.7 (13.3)</td>
<td>$t(2743) = 16.99^{***}$</td>
</tr>
</tbody>
</table>

*Note. Within columns within variables, different superscripts signify that proportions among groups differ significantly. Superscripts are not included where follow-up comparisons are not required.*

*p < 0.05. **p ≤ 0.01. ***p ≤ 0.001.*
### Table 3

**Logistic Regression Predicting Peak Drinking Time from 9pm Onwards (vs. Day/Evening), N = 2814**

<table>
<thead>
<tr>
<th></th>
<th>Step 1: Age and Covariates</th>
<th>95% CI for AOR</th>
<th>Step 2: Chronotype</th>
<th>95% CI for AOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-0.56 0.57 &lt;0.001</td>
<td></td>
<td>-1.16 0.31 &lt;0.001</td>
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</tr>
<tr>
<td>Race and Ethnicity (ref. White)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men of color</td>
<td>0.45 1.57 &lt;0.001 [1.33, 1.85]</td>
<td></td>
<td>0.51 1.66 &lt;0.001 [1.40, 1.97]</td>
<td></td>
</tr>
<tr>
<td>Recruitment Source (ref. Hookup/porn Sites)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hookup App &amp; Facebook</td>
<td>0.37 1.45 &lt;0.001 [1.22, 1.72]</td>
<td></td>
<td>0.36 1.44 &lt;0.001 [1.21, 1.72]</td>
<td></td>
</tr>
<tr>
<td>Relationship Status (ref. Partnered)</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single</td>
<td>0.31 1.37 &lt;0.001 [1.16, 1.61]</td>
<td></td>
<td>0.27 1.31 &lt;0.01 [1.11, 1.55]</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>-0.04 0.96 &lt;0.001 [0.95, 0.97]</td>
<td></td>
<td>-0.03 0.97 &lt;0.001 [0.96, 0.97]</td>
<td></td>
</tr>
<tr>
<td>Chronotype (ref. Morning Type)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neither Type</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evening Type</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Model Statistics:**
- Model $\chi^2(4) = 353.13^{***}$
- Hosmer & Lemeshow:
  - $\chi^2(8) = 12.75$, $p = 0.12$
  - Percentage correctly classified = 64.8
- Step $\chi^2(2) = 95.14^{***}$
- Hosmer & Lemeshow:
  - $\chi^2(8) = 5.12$, $p = 0.75$
  - Percentage correctly classified = 66.1

*Note.* AOR = adjusted odds ratio; CI = confidence interval; ref. = referent.

*p < 0.05. **p ≤ 0.01. ***p ≤ 0.001.
Table 4

Demographics of the One Thousand Strong Sample and Comparisons for the Analytic Sample

<table>
<thead>
<tr>
<th>Demographics</th>
<th>Total</th>
<th>Alcohol use</th>
<th>No alcohol use</th>
<th>Test Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n (%)</td>
<td>n (%)</td>
<td>n (%)</td>
<td></td>
</tr>
<tr>
<td>Overall</td>
<td>1113 (100)</td>
<td>927 (100)</td>
<td>186 (100)</td>
<td></td>
</tr>
<tr>
<td>Race and Ethnicity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black</td>
<td>135 (12.1)</td>
<td>113 (12.2)</td>
<td>22 (11.8)</td>
<td></td>
</tr>
<tr>
<td>Latino</td>
<td>177 (15.9)</td>
<td>162 (17.5)&lt;sup&gt;a&lt;/sup&gt;</td>
<td>15 (8.1)&lt;sup&gt;b&lt;/sup&gt;</td>
<td>$\chi^2(3) = 10.79^*$</td>
</tr>
<tr>
<td>White</td>
<td>699 (62.8)</td>
<td>570 (61.5)&lt;sup&gt;a&lt;/sup&gt;</td>
<td>129 (69.4)&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>Multiracial/Other</td>
<td>102 (9.2)</td>
<td>82 (8.8)</td>
<td>20 (10.8)</td>
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</tr>
<tr>
<td>Sexual Identity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gay</td>
<td>1061 (95.3)</td>
<td>886 (95.6)</td>
<td>175 (94.1)</td>
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</tr>
<tr>
<td>Bisexual</td>
<td>52 (4.7)</td>
<td>41 (4.4)</td>
<td>11 (5.9)</td>
<td>$\chi^2(1) = 0.38$</td>
</tr>
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<td>Relationship Status</td>
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</tr>
<tr>
<td>Single</td>
<td>542 (48.7)</td>
<td>442 (47.7)</td>
<td>100 (53.8)</td>
<td>$\chi^2(1) = 2.29$</td>
</tr>
<tr>
<td>Partnered</td>
<td>571 (51.3)</td>
<td>485 (52.3)</td>
<td>86 (46.2)</td>
<td></td>
</tr>
<tr>
<td>Income</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Below $50K</td>
<td>557 (50.0)</td>
<td>461 (49.7)</td>
<td>96 (51.6)</td>
<td>$\chi^2(1) = 0.22$</td>
</tr>
<tr>
<td>$50K$ or above</td>
<td>556 (50.0)</td>
<td>466 (50.3)</td>
<td>90 (48.4)</td>
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</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High school/GED/less</td>
<td>69 (6.2)</td>
<td>55 (5.9)</td>
<td>14 (7.5)</td>
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</tr>
<tr>
<td>Some college</td>
<td>374 (33.6)</td>
<td>309 (33.3)</td>
<td>65 (34.9)</td>
<td>$\chi^2(3) = 1.02$</td>
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<tr>
<td>4-year college degree</td>
<td>338 (30.4)</td>
<td>284 (30.6)</td>
<td>54 (29.0)</td>
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<tr>
<td>Graduate degree</td>
<td>332 (29.8)</td>
<td>279 (30.1)</td>
<td>53 (28.5)</td>
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</tr>
<tr>
<td>Chronotype</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Morning Type</td>
<td>240 (21.6)</td>
<td>194 (20.9)</td>
<td>46 (24.7)</td>
<td>$\chi^2(2) = 1.65$</td>
</tr>
<tr>
<td>Neither Type</td>
<td>555 (49.9)</td>
<td>469 (50.6)</td>
<td>54 (29.0)</td>
<td></td>
</tr>
<tr>
<td>Evening Type</td>
<td>318 (28.6)</td>
<td>264 (28.5)</td>
<td>86 (46.2)</td>
<td></td>
</tr>
<tr>
<td>M (SD)</td>
<td></td>
<td>M (SD)</td>
<td>M (SD)</td>
<td></td>
</tr>
<tr>
<td>Age (years)</td>
<td>41.4 (13.6)</td>
<td>40.8 (13.5)</td>
<td>44.0 (14.1)</td>
<td>$t(1111) = 2.92^{**}$</td>
</tr>
</tbody>
</table>

Note. Within rows within categorical variables, cells with different superscripts differ significantly. Superscripts are not included where follow-up comparisons are not required. 

* $p < 0.05$. ** $p \leq 0.01$. *** $p \leq 0.001$. 


### Table 5

*Bivariate Associations Between Age and Chronotype on Use of Alcohol to Help Stay Awake Longer, N = 927*

<table>
<thead>
<tr>
<th></th>
<th>None</th>
<th>At least sometimes</th>
<th>Total</th>
<th>Test Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n (%)</td>
<td>n (%)</td>
<td>n</td>
<td></td>
</tr>
<tr>
<td><strong>Overall</strong></td>
<td>435 (46.9)</td>
<td>492 (53.1)</td>
<td>927</td>
<td></td>
</tr>
<tr>
<td><strong>Chronotype</strong></td>
<td></td>
<td></td>
<td></td>
<td>$\chi^2(2) = 10.13^{**}$</td>
</tr>
<tr>
<td>Morning Type</td>
<td>109 (56.2)</td>
<td>85 (43.8)</td>
<td>194 $^a$</td>
<td></td>
</tr>
<tr>
<td>Neither Type</td>
<td>217 (46.3)</td>
<td>252 (53.7)</td>
<td>469 $^{ab}$</td>
<td></td>
</tr>
<tr>
<td>Evening Type</td>
<td>109 (41.3)</td>
<td>155 (58.7)</td>
<td>264 $^b$</td>
<td></td>
</tr>
<tr>
<td><strong>Age (years)</strong></td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>$t(925) = 9.40^{***}$</td>
</tr>
<tr>
<td>45.0 (14.0)</td>
<td>37.1 (11.7)</td>
<td>40.8 (13.5)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note. Within columns within variables, different superscripts signify that proportions among groups differ significantly. Superscripts are not included where follow-up comparisons are not required. *$p < 0.05$. **$p \leq 0.01$. ***$p \leq 0.001$.***
Table 6

*Logistic Regression Predicting Any Use of Alcohol to Help Stay Awake Longer, N = 927*

<table>
<thead>
<tr>
<th></th>
<th>Step 1: Age</th>
<th></th>
<th>Step 2: Age and chronotype</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B  AOR</td>
<td>95% CI for AOR</td>
<td>B  AOR</td>
</tr>
<tr>
<td>Constant</td>
<td>0.13  1.14</td>
<td>0.07</td>
<td>0.10   1.10</td>
</tr>
<tr>
<td>Age</td>
<td>-0.05  0.95</td>
<td>&lt;0.001 [0.94, 0.97]</td>
<td>-0.05  0.96</td>
</tr>
<tr>
<td>Chronotype (ref. Morning Type)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neither Type</td>
<td></td>
<td></td>
<td>0.03    1.03</td>
</tr>
<tr>
<td>Evening Type</td>
<td></td>
<td></td>
<td>0.06    1.06</td>
</tr>
<tr>
<td>Model Statistics:</td>
<td></td>
<td></td>
<td>Step $\chi^2(2) = 0.07$, $p = 0.96$</td>
</tr>
<tr>
<td>Model $\chi^2(1) = 82.98^{***}$</td>
<td></td>
<td></td>
<td>Hosmer &amp; Lemeshow:</td>
</tr>
<tr>
<td>Hosmer &amp; Lemeshow:</td>
<td></td>
<td></td>
<td>$\chi^2(8) = 11.76$, $p = 0.16$</td>
</tr>
<tr>
<td>$\chi^2(8) = 9.63$, $p = 0.29$</td>
<td></td>
<td></td>
<td>Percentage correctly classified = 64.2</td>
</tr>
<tr>
<td>Percentage correctly classified = 64.5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note.* AOR = adjusted odds ratio; CI = confidence interval; ref. = referent.

*\*p < 0.05. **p = 0.01. ***p ≤ 0.001.*
Table 7

Demographics for the day2day Sample, N = 52

<table>
<thead>
<tr>
<th>Demographics</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
</tr>
<tr>
<td>Overall</td>
<td>52</td>
</tr>
<tr>
<td>Race and Ethnicity</td>
<td></td>
</tr>
<tr>
<td>Black</td>
<td>18</td>
</tr>
<tr>
<td>Latino</td>
<td>14</td>
</tr>
<tr>
<td>White</td>
<td>11</td>
</tr>
<tr>
<td>Multiracial/Other</td>
<td>8</td>
</tr>
<tr>
<td>Sexual Identity</td>
<td></td>
</tr>
<tr>
<td>Gay</td>
<td>45</td>
</tr>
<tr>
<td>Bisexual</td>
<td>6</td>
</tr>
<tr>
<td>Relationship Status</td>
<td></td>
</tr>
<tr>
<td>Single</td>
<td>38</td>
</tr>
<tr>
<td>Partnered</td>
<td>13</td>
</tr>
<tr>
<td>Income</td>
<td></td>
</tr>
<tr>
<td>Below $30K</td>
<td>31</td>
</tr>
<tr>
<td>$30K or above</td>
<td>20</td>
</tr>
<tr>
<td>Education</td>
<td></td>
</tr>
<tr>
<td>High school/GED or less</td>
<td>9</td>
</tr>
<tr>
<td>Some college</td>
<td>28</td>
</tr>
<tr>
<td>4-year college degree</td>
<td>9</td>
</tr>
<tr>
<td>Graduate degree</td>
<td>5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>38.7</td>
<td>10.2</td>
</tr>
<tr>
<td>10.8</td>
<td>6.8</td>
</tr>
</tbody>
</table>

Note. Percentages do not sum to 100 as data are missing for one participant
Table 8

*Multilevel Multinomial Models with Sleep Quality Predicting Alcohol Use*

<table>
<thead>
<tr>
<th></th>
<th>Model A:</th>
<th>Model B:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No Drinks vs. Any Drinks</td>
<td>1-4 Drinks vs. Heavy Drinking</td>
</tr>
<tr>
<td>B</td>
<td>AOR</td>
<td>95% CI for B</td>
</tr>
<tr>
<td>Intercept</td>
<td>-1.32</td>
<td>0.27</td>
</tr>
<tr>
<td></td>
<td>[0.16, 0.46]</td>
<td>[0.10, 0.37]</td>
</tr>
<tr>
<td>Level 1: Within-person</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Daily sleep quality</td>
<td>-0.03</td>
<td>0.97</td>
</tr>
<tr>
<td></td>
<td>[0.78, 1.20]</td>
<td>[1.01, 2.14]</td>
</tr>
<tr>
<td>Weekend (ref. non-Weekend)</td>
<td>0.38</td>
<td>1.47</td>
</tr>
<tr>
<td></td>
<td>[1.01, 2.14]</td>
<td>[1.72, 6.95]</td>
</tr>
<tr>
<td>Days across diary period</td>
<td>-0.02</td>
<td>0.98</td>
</tr>
<tr>
<td></td>
<td>[0.95, 1.01]</td>
<td>[0.99, 1.12]</td>
</tr>
<tr>
<td>Level 2: Between-person</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average sleep quality</td>
<td>0.09</td>
<td>1.09</td>
</tr>
<tr>
<td></td>
<td>[0.65, 1.84]</td>
<td>[0.46, 1.49]</td>
</tr>
<tr>
<td>Age</td>
<td>-0.02</td>
<td>0.98</td>
</tr>
<tr>
<td></td>
<td>[0.94, 1.02]</td>
<td>[0.91, 1.02]</td>
</tr>
<tr>
<td>Variance Parameters (Random Effects)</td>
<td>95% CI for B</td>
<td>95% CI for B</td>
</tr>
<tr>
<td>Intercept</td>
<td>2.47</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Daily sleep quality</td>
<td>0.12</td>
<td>0.26</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note.* AOR = adjusted odds ratio; CI = confidence interval; ref. = referent.
### Table 9

**Demographics of the One Thousand Strong Sample and Comparisons for the Analytic Sample**

<table>
<thead>
<tr>
<th>Demographics</th>
<th>Total n (%)</th>
<th>Included n (%)</th>
<th>Excluded n (%)</th>
<th>Test Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Overall</strong></td>
<td>1113 (100)</td>
<td>344 (30.9)</td>
<td>769 (69.1)</td>
<td></td>
</tr>
<tr>
<td>Race and Ethnicity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black</td>
<td>135 (12.1)</td>
<td>59 (17.2)(a)</td>
<td>76 (9.9)(b)</td>
<td>(\chi^2(3) = 18.03^{***})</td>
</tr>
<tr>
<td>Latino</td>
<td>177 (15.9)</td>
<td>59 (17.2)</td>
<td>118 (15.3)</td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>699 (62.8)</td>
<td>188 (54.7)(a)</td>
<td>511 (66.4)(b)</td>
<td></td>
</tr>
<tr>
<td>Multiracial/Other</td>
<td>102 (9.2)</td>
<td>38 (11.0)</td>
<td>64 (8.3)</td>
<td></td>
</tr>
<tr>
<td>Sexual Identity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gay</td>
<td>1061 (95.3)</td>
<td>325 (94.5)</td>
<td>736 (95.7)</td>
<td>(\chi^2(1) = 0.81)</td>
</tr>
<tr>
<td>Bisexual</td>
<td>52 (4.7)</td>
<td>19 (5.5)</td>
<td>33 (4.3)</td>
<td></td>
</tr>
<tr>
<td>Relationship Status</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single</td>
<td>542 (48.7)</td>
<td>235 (68.3)</td>
<td>307 (39.9)</td>
<td>(\chi^2(1) = 76.69^{***})</td>
</tr>
<tr>
<td>Partnered</td>
<td>571 (51.3)</td>
<td>109 (31.7)</td>
<td>462 (60.1)</td>
<td></td>
</tr>
<tr>
<td>Income</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Below $50K</td>
<td>557 (50.0)</td>
<td>176 (51.2)</td>
<td>381 (49.5)</td>
<td>(\chi^2(1) = 0.25)</td>
</tr>
<tr>
<td>$50K or above</td>
<td>556 (50.0)</td>
<td>168 (48.8)</td>
<td>388 (50.5)</td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High school/GED/less</td>
<td>69 (6.2)</td>
<td>21 (6.1)</td>
<td>48 (6.2)</td>
<td></td>
</tr>
<tr>
<td>Some college</td>
<td>374 (33.6)</td>
<td>107 (31.1)</td>
<td>267 (34.7)</td>
<td>(\chi^2(3) = 1.60)</td>
</tr>
<tr>
<td>4-year college degree</td>
<td>338 (30.4)</td>
<td>107 (31.1)</td>
<td>231 (30.0)</td>
<td></td>
</tr>
<tr>
<td>Graduate degree</td>
<td>332 (29.8)</td>
<td>109 (31.7)</td>
<td>223 (29.0)</td>
<td></td>
</tr>
<tr>
<td>Chronotype</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Morning Type</td>
<td>240 (21.6)</td>
<td>62 (18.0)</td>
<td>173 (23.1)</td>
<td></td>
</tr>
<tr>
<td>Neither Type</td>
<td>555 (49.9)</td>
<td>180 (52.3)</td>
<td>375 (48.8)</td>
<td>(\chi^2(2) = 3.70)</td>
</tr>
<tr>
<td>Evening Type</td>
<td>318 (28.6)</td>
<td>102 (29.7)</td>
<td>216 (28.1)</td>
<td></td>
</tr>
<tr>
<td>Last CAS with casual male partner, n = 809</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>During the day</td>
<td>244 (30.2)</td>
<td>108 (31.4)</td>
<td>136 (29.2)</td>
<td></td>
</tr>
<tr>
<td>Evening, 5-9pm</td>
<td>130 (16.1)</td>
<td>66 (19.2)</td>
<td>64 (13.8)</td>
<td>(\chi^2(3) = 6.42)</td>
</tr>
<tr>
<td>Night, 9pm-midnight</td>
<td>199 (24.6)</td>
<td>81 (23.5)</td>
<td>118 (25.4)</td>
<td></td>
</tr>
<tr>
<td>After Midnight</td>
<td>236 (29.2)</td>
<td>89 (25.9)</td>
<td>147 (31.6)</td>
<td></td>
</tr>
<tr>
<td>Last sex with condoms with casual male partner, n = 958</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>During the day</td>
<td>294 (30.7)</td>
<td>119 (34.6)</td>
<td>175 (28.5)</td>
<td></td>
</tr>
<tr>
<td>Evening, 5-9pm</td>
<td>169 (17.6)</td>
<td>65 (18.9)</td>
<td>104 (16.9)</td>
<td>(\chi^2(3) = 6.92)</td>
</tr>
<tr>
<td>Night, 9pm-midnight</td>
<td>265 (27.7)</td>
<td>91 (26.5)</td>
<td>174 (28.3)</td>
<td></td>
</tr>
<tr>
<td>After Midnight</td>
<td>230 (24.0)</td>
<td>69 (20.1)</td>
<td>161 (26.2)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>M (SD)</th>
<th>M (SD)</th>
<th>M (SD)</th>
</tr>
</thead>
</table>

102
<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Included</th>
<th>Excluded</th>
<th>t(1111) = 5.04***</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>41.4 (13.6)</td>
<td>38.3 (12.4)</td>
<td>42.7 (13.9)</td>
</tr>
</tbody>
</table>

*Note.* ‘Included’ refers to the analytic sample included in subsequent regression analyses. ‘Excluded’ refers to those not reporting past-year CAS and sex with condoms with casual male partners. Within rows within variables, cells with different superscripts differ significantly. Superscripts are not included where follow-up comparisons are not required.

*p* < 0.05. **p* ≤ 0.01. ***p* ≤ 0.001.
## Table 10

*Biivariate Comparisons of Age and Chronotype by Time of Last Sex (CAS and With Condoms) with a Casual Male Partner*

<table>
<thead>
<tr>
<th>Time of last CAS</th>
<th>Daytime, 6am to 5pm</th>
<th>Evening, 5-9pm</th>
<th>From 9pm to midnight</th>
<th>After Midnight</th>
<th>Total</th>
<th>Test Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td>108 (31.4)</td>
<td>66 (19.2)</td>
<td>81 (23.5)</td>
<td>89 (25.9)</td>
<td>344</td>
<td></td>
</tr>
<tr>
<td>Chronotype</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>χ²(6) = 10.20</td>
</tr>
<tr>
<td>Morning Type</td>
<td>25 (40.3)</td>
<td>15 (24.2)</td>
<td>10 (16.1)</td>
<td>12 (19.4)</td>
<td>62</td>
<td>p = 0.12</td>
</tr>
<tr>
<td>Neither Type</td>
<td>55 (30.6)</td>
<td>34 (18.9)</td>
<td>49 (27.2)</td>
<td>42 (23.3)</td>
<td>180</td>
<td></td>
</tr>
<tr>
<td>Evening Type</td>
<td>28 (27.5)</td>
<td>17 (16.7)</td>
<td>22 (21.6)</td>
<td>35 (34.3)</td>
<td>102</td>
<td></td>
</tr>
<tr>
<td>Age (years)</td>
<td>40.7 (1.2)</td>
<td>41.1 (1.5)</td>
<td>36.3 (1.3)</td>
<td>35.1 (1.3)</td>
<td>38.3 (12.4)</td>
<td>F(3,340) = 5.44**</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Time of last sex with condoms</th>
<th>Daytime, 6am to 5pm</th>
<th>Evening, 5-9pm</th>
<th>From 9pm to midnight</th>
<th>After Midnight</th>
<th>Total</th>
<th>Test Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td>119 (34.6)</td>
<td>65 (18.9)</td>
<td>91 (26.5)</td>
<td>69 (20.1)</td>
<td>344</td>
<td></td>
</tr>
<tr>
<td>Chronotype</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>χ²(6) = 16.78**</td>
</tr>
<tr>
<td>Morning Type</td>
<td>30 (48.4)</td>
<td>10 (16.1)</td>
<td>15 (24.2)</td>
<td>7 (11.3)</td>
<td>62</td>
<td></td>
</tr>
<tr>
<td>Neither Type</td>
<td>66 (36.7)</td>
<td>38 (21.1)</td>
<td>42 (23.3)</td>
<td>34 (18.9)</td>
<td>180</td>
<td></td>
</tr>
<tr>
<td>Evening Type</td>
<td>23 (22.5)</td>
<td>17 (16.7)</td>
<td>34 (33.3)</td>
<td>28 (27.5)</td>
<td>102</td>
<td></td>
</tr>
<tr>
<td>Age (years)</td>
<td>39.2 (1.1)</td>
<td>39.0 (1.5)</td>
<td>38.2 (1.3)</td>
<td>36.2 (1.5)</td>
<td>38.3 (12.4)</td>
<td>F(3,340) = 0.97</td>
</tr>
</tbody>
</table>

*Note. Within columns within variables, different superscripts signify that proportions among groups differ significantly. Within rows within continuous variables, cells with different superscripts differ significantly by estimated marginal means.*

*<p> < 0.05. **<p> ≤ 0.01. ***<p> ≤ 0.001.*
Table 11

*Logistic Regression Predicting CAS from 9pm Onwards (vs. Day/Evening) with a Casual Male Partner, N = 344*

<table>
<thead>
<tr>
<th>Time of last CAS</th>
<th>B</th>
<th>AOR</th>
<th>p</th>
<th>95% CI for AOR</th>
<th>Step 1</th>
<th>B</th>
<th>AOR</th>
<th>p</th>
<th>95% CI for AOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-0.26</td>
<td>0.77</td>
<td>0.16</td>
<td>[0.91, 2.25]</td>
<td>-0.54</td>
<td>0.58</td>
<td>0.08</td>
<td>[0.89, 2.19]</td>
<td></td>
</tr>
<tr>
<td>Race and Ethnicity (ref. White)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men of color</td>
<td>0.36</td>
<td>1.43</td>
<td>0.12</td>
<td>[0.91, 2.25]</td>
<td>0.33</td>
<td>1.39</td>
<td>0.15</td>
<td>[0.89, 2.19]</td>
<td></td>
</tr>
<tr>
<td>Income (ref. $50K or more)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>More than $50K</td>
<td>0.07</td>
<td>1.07</td>
<td>0.76</td>
<td>[0.69, 1.68]</td>
<td>0.07</td>
<td>1.07</td>
<td>0.78</td>
<td>[0.68, 1.67]</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>-0.03</td>
<td>0.97</td>
<td>&lt;0.01</td>
<td>[0.95, 0.99]</td>
<td>-0.03</td>
<td>0.97</td>
<td>&lt;0.01</td>
<td>[0.95, 0.99]</td>
<td></td>
</tr>
<tr>
<td>Chronotype (ref. Morning Type)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neither Type</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evening Type</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Model Statistics:
- Model $\chi^2(1) = 18.25^{***}$
- Hosmer & Lemeshow $\chi^2(8) = 4.35, p = 0.82$
- Percentage correctly classified = 61.6

Step $\chi^2(1) = 1.48, p = 0.48$
- Hosmer & Lemeshow $\chi^2(8) = 5.24, p = 0.73$
- Percentage correctly classified = 59.6

*Note. AOR = adjusted odds ratio; CI = confidence interval; ref. = referent.

*p < 0.05. **p ≤ 0.01. ***p ≤ 0.001.*
Table 12

Logistic Regression Predicting Sex With Condoms from 9pm onwards (vs. Day/Evening) with a Casual Male Partner, N = 344

<table>
<thead>
<tr>
<th>Time of last sex with condoms</th>
<th>B</th>
<th>AOR</th>
<th>p</th>
<th>95% CI for AOR</th>
<th>B</th>
<th>AOR</th>
<th>p</th>
<th>95% CI for AOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-0.31</td>
<td>0.74</td>
<td>0.09</td>
<td></td>
<td>-0.70</td>
<td>0.50</td>
<td>0.02</td>
<td></td>
</tr>
<tr>
<td>Race and Ethnicity (ref. White)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men of color</td>
<td>-0.10</td>
<td>0.91</td>
<td>0.66</td>
<td>[0.58, 1.42]</td>
<td>-0.20</td>
<td>0.82</td>
<td>0.40</td>
<td>[0.52, 1.30]</td>
</tr>
<tr>
<td>Income (ref. Less than $50K)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$50K or more</td>
<td>0.39</td>
<td>1.48</td>
<td>0.08</td>
<td>[0.58, 1.42]</td>
<td>0.38</td>
<td>1.46</td>
<td>0.10</td>
<td>[0.93, 2.28]</td>
</tr>
<tr>
<td>Age</td>
<td>-0.02</td>
<td>0.98</td>
<td>0.03</td>
<td>[0.96, 1.00]</td>
<td>0.00</td>
<td>1.00</td>
<td>0.82</td>
<td>[0.98, 1.02]</td>
</tr>
<tr>
<td>Chronotype (ref. Morning Type)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neither Type</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evening Type</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Model Statistics:
- Model $\chi^2(1) = 4.97$
- Hosmer & Lemeshow $\chi^2(8) = 9.53$, $p = 0.30$
- Percentage correctly classified = 57.8

Step $\chi^2(2) = 11.12^{**}$
- Hosmer & Lemeshow $\chi^2(8) = 7.40$, $p = 0.50$
- Percentage correctly classified = 59.9

*Note. AOR = adjusted odds ratio; CI = confidence interval; ref. = referent.

*p < 0.05. **p ≤ 0.01. ***p ≤ 0.001.
### Table 13

*Bivariate Associations Between Age, Chronotype, and Sexual Position Identity with Whether Tiredness Decreases Sexual Desire*

<table>
<thead>
<tr>
<th></th>
<th>Does not change my desire</th>
<th>Reduces desire a little bit</th>
<th>Reduces desire a lot</th>
<th>Reduces desire completely</th>
<th>Total</th>
<th>Test Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Overall</strong></td>
<td>261 (23.5)</td>
<td>487 (43.8)</td>
<td>306 (27.5)</td>
<td>59 (5.3)</td>
<td>1113 (100)</td>
<td></td>
</tr>
<tr>
<td><strong>Chronotype</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(\chi^2(6) = 3.79,) (p = 0.71)</td>
</tr>
<tr>
<td>Morning Type</td>
<td>59 (24.6)</td>
<td>100 (41.7)</td>
<td>66 (27.5)</td>
<td>15 (6.3)</td>
<td>240 (21.6)</td>
<td></td>
</tr>
<tr>
<td>Neither Type</td>
<td>121 (21.8)</td>
<td>251 (45.2)</td>
<td>158 (28.5)</td>
<td>25 (4.5)</td>
<td>555 (49.9)</td>
<td></td>
</tr>
<tr>
<td>Evening Type</td>
<td>81 (25.5)</td>
<td>136 (42.8)</td>
<td>82 (25.8)</td>
<td>19 (6.0)</td>
<td>318 (28.6)</td>
<td></td>
</tr>
<tr>
<td><strong>Sexual Position Identity</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(\chi^2(12) = 9.85,) (p = 0.63)</td>
</tr>
<tr>
<td>Top</td>
<td>52 (23.5)</td>
<td>93 (42.1)</td>
<td>63 (28.5)</td>
<td>13 (5.9)</td>
<td>221 (19.9)</td>
<td></td>
</tr>
<tr>
<td>Versatile/Top</td>
<td>61 (24.3)</td>
<td>114 (45.4)</td>
<td>60 (23.9)</td>
<td>16 (6.4)</td>
<td>251 (22.6)</td>
<td></td>
</tr>
<tr>
<td>Versatile</td>
<td>52 (22.1)</td>
<td>111 (47.2)</td>
<td>57 (24.3)</td>
<td>15 (6.4)</td>
<td>235 (21.1)</td>
<td></td>
</tr>
<tr>
<td>Versatile/Bottom</td>
<td>58 (22.2)</td>
<td>112 (42.9)</td>
<td>82 (31.4)</td>
<td>9 (3.4)</td>
<td>261 (23.5)</td>
<td></td>
</tr>
<tr>
<td>Bottom</td>
<td>38 (26.2)</td>
<td>57 (39.3)</td>
<td>44 (30.3)</td>
<td>6 (4.1)</td>
<td>145 (13.0)</td>
<td></td>
</tr>
</tbody>
</table>

\[ M (SE) \quad M (SE) \quad M (SE) \quad M (SD) \]

Age (years) 
40.3 (0.8)^a  
40.8 (0.6)^a  
43.3 (0.8)^b  
40.5 (1.8)^ab  
41.3 (13.6)  
\(F(3,1109) = 2.95^*\)

*Note. Within rows within continuous variables, cells with different superscripts differ significantly by estimated marginal means.  
*\(p < 0.05.\)  **\(p \leq 0.01.\)  ***\(p \leq 0.001.\)*
Table 14

**Bivariate Associations Between Age, Chronotype, and Sexual Position Identity with Whether Tiredness Increases Sexual Desire**

<table>
<thead>
<tr>
<th></th>
<th>Does not increase</th>
<th>Can increase</th>
<th>Total</th>
<th>Test Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n (%)</td>
<td>n (%)</td>
<td>n</td>
<td></td>
</tr>
<tr>
<td>Overall</td>
<td>788 (70.8)</td>
<td>325 (29.2)</td>
<td>1113</td>
<td></td>
</tr>
<tr>
<td>Chronotype</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Morning Type</td>
<td>180 (75.0)</td>
<td>60 (25.0)</td>
<td>240</td>
<td>χ²(2) = 5.76,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>p = 0.06</td>
</tr>
<tr>
<td>Neither Type</td>
<td>398 (71.7)</td>
<td>157 (28.3)</td>
<td>555</td>
<td></td>
</tr>
<tr>
<td>Evening Type</td>
<td>210 (66.0)</td>
<td>108 (34.0)</td>
<td>318</td>
<td></td>
</tr>
<tr>
<td>Sexual Position Identity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Top</td>
<td>167 (75.6)</td>
<td>54 (24.4)</td>
<td>221</td>
<td>χ²(4) = 3.65,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>p = 0.46</td>
</tr>
<tr>
<td>Versatile/Top</td>
<td>172 (68.5)</td>
<td>79 (31.5)</td>
<td>251</td>
<td></td>
</tr>
<tr>
<td>Versatile</td>
<td>164 (69.8)</td>
<td>71 (30.2)</td>
<td>235</td>
<td></td>
</tr>
<tr>
<td>Versatile/Bottom</td>
<td>186 (71.3)</td>
<td>75 (28.7)</td>
<td>261</td>
<td></td>
</tr>
<tr>
<td>Bottom</td>
<td>99 (68.3)</td>
<td>46 (31.7)</td>
<td>145</td>
<td></td>
</tr>
<tr>
<td>Age (years)</td>
<td>42.4 (13.5)</td>
<td>38.6 (13.5)</td>
<td>41.3 (13.6)</td>
<td>t(1111) = 4.28***</td>
</tr>
</tbody>
</table>

*p < 0.05. **p ≤ 0.01. ***p ≤ 0.001.
Table 15

*Logistic Regressions Predicting Whether Tiredness Increases Sexual Desire, N = 1113*

<table>
<thead>
<tr>
<th></th>
<th>Step 1: Age</th>
<th></th>
<th>Step 2: Age and Chronotype</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>AOR</td>
<td>p</td>
<td>B</td>
</tr>
<tr>
<td>Constant</td>
<td>-0.90</td>
<td>0.41</td>
<td>&lt;0.001</td>
<td>-0.96</td>
</tr>
<tr>
<td>Age</td>
<td>-0.02</td>
<td>0.98</td>
<td>&lt;0.001 [0.97 0.99]</td>
<td>-0.02</td>
</tr>
<tr>
<td>Chronotype (ref. Morning Type)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neither Type</td>
<td>0.02</td>
<td>1.00</td>
<td>0.99 [0.70, 1.43]</td>
<td></td>
</tr>
<tr>
<td>Evening Type</td>
<td>0.19</td>
<td>1.21</td>
<td>0.34 [0.82, 1.80]</td>
<td></td>
</tr>
</tbody>
</table>

Model Statistics:  
Model $\chi^2(1) = 18.47^{***}$  
Hosmer & Lemeshow:  
$\chi^2(8) = 15.65, p = 0.05$  
Percentage correctly classified = 70.8

Step $\chi^2(2) = 1.70, p = 0.43$  
Hosmer & Lemeshow:  
$\chi^2(8) = 8.40, p = 0.40$  
Percentage correctly classified = 70.8

*Note. AOR = adjusted odds ratio; CI = confidence interval; ref. = referent
*p < 0.05. **p ≤ 0.01. ***p ≤ 0.001.
Table 16

Bivariate Associations Between Age, Chronotype, and Sexual Position Identity with the Effect of Tiredness on Sexual Positioning

<table>
<thead>
<tr>
<th></th>
<th>Would not change</th>
<th>More likely to top</th>
<th>More likely to bottom</th>
<th>Total</th>
<th>Test Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n (%)</td>
<td>n (%)</td>
<td>n (%)</td>
<td>n</td>
<td></td>
</tr>
<tr>
<td>Overall</td>
<td>757 (68.0)</td>
<td>67 (6.0)</td>
<td>289 (26.0)</td>
<td>1113</td>
<td></td>
</tr>
<tr>
<td>Chronotype</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Morning Type</td>
<td>174 (72.5)</td>
<td>8 (3.3)</td>
<td>58 (24.2)</td>
<td>240</td>
<td>$\chi^2(4) = 5.67, p = 0.23$</td>
</tr>
<tr>
<td>Neither Type</td>
<td>374 (67.4)</td>
<td>39 (7.0)</td>
<td>142 (25.6)</td>
<td>555</td>
<td></td>
</tr>
<tr>
<td>Evening Type</td>
<td>209 (65.7)</td>
<td>20 (6.3)</td>
<td>89 (28.0)</td>
<td>318</td>
<td></td>
</tr>
<tr>
<td>Sexual Position Identity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Top</td>
<td>197 (89.1)</td>
<td>16 (7.2)</td>
<td>8 (3.6)$^a$</td>
<td>221</td>
<td></td>
</tr>
<tr>
<td>Versatile/Top</td>
<td>176 (70.1)</td>
<td>22 (8.8)</td>
<td>53 (21.1)$^b$</td>
<td>251</td>
<td></td>
</tr>
<tr>
<td>Versatile</td>
<td>131 (55.7)</td>
<td>16 (6.8)</td>
<td>88 (37.4)$^c$</td>
<td>235</td>
<td>$\chi^2(8) = 107.14^{***}$</td>
</tr>
<tr>
<td>Versatile/Bottom</td>
<td>151 (57.9)</td>
<td>13 (5.0)</td>
<td>97 (37.2)$^c$</td>
<td>261</td>
<td></td>
</tr>
<tr>
<td>Bottom</td>
<td>102 (70.3)</td>
<td>0 (0)</td>
<td>43 (29.7)$^{bc}$</td>
<td>145</td>
<td></td>
</tr>
<tr>
<td>Age (years)</td>
<td>42.5 (0.5)$^a$</td>
<td>39.3 (0.8)$^b$</td>
<td>37.5 (1.6)$^b$</td>
<td>41.3 (13.6)</td>
<td>$F(2,1110) = 8.67^{***}$</td>
</tr>
</tbody>
</table>

Note. Within the ‘more likely to bottom’ column within variables, different superscripts signify that proportions among groups differ significantly. Within rows within continuous variables, cells with different superscripts differ significantly by estimated marginal means.

* $p < 0.05$. ** $p \leq 0.01$. *** $p \leq 0.001$. 
### Table 17

**Logistic Regressions Predicting Receptive Anal Sex Positioning When Tired**

<table>
<thead>
<tr>
<th></th>
<th>Step 1:</th>
<th>Step 2:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>B</strong></td>
<td><strong>AOR</strong></td>
</tr>
<tr>
<td><strong>Constant</strong></td>
<td>-1.06</td>
<td>0.35</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td>-0.02</td>
<td>0.99</td>
</tr>
<tr>
<td><strong>Positioning Identity (ref. Top)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Top/Versatile</td>
<td>1.94</td>
<td>6.93</td>
</tr>
<tr>
<td>Versatile</td>
<td>2.73</td>
<td>15.39</td>
</tr>
<tr>
<td>Bottom/Versatile</td>
<td>2.71</td>
<td>15.01</td>
</tr>
<tr>
<td>Bottom</td>
<td>2.39</td>
<td>10.90</td>
</tr>
</tbody>
</table>

Model $\chi^2(1) = 9.20^{**}$  
Hosmer & Lemeshow:  
$\chi^2(8) = 8.79, p = 0.36$  
Percentage correctly classified = 74.0

Step $\chi^2(4) = 109.86^{***}$  
Hosmer & Lemeshow:  
$\chi^2(8) = 8.66, p = 0.37$  
Percentage correctly classified = 74.0

*Note. AOR = adjusted odds ratio; CI = confidence interval; ref. = referent  
*p < 0.05. **p ≤ 0.01. ***p ≤ 0.001.*
<table>
<thead>
<tr>
<th></th>
<th>Model A: No Sex vs. Any Sex</th>
<th>Model B: Sex with no CAS vs. CAS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>AOR</td>
</tr>
<tr>
<td>Intercept</td>
<td>-1.53</td>
<td>0.22</td>
</tr>
<tr>
<td>Level 1: Within-person</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Daily sleep quality</td>
<td>-0.01</td>
<td>0.99</td>
</tr>
<tr>
<td>Weekend (ref. non-weekend)</td>
<td>0.11</td>
<td>1.11</td>
</tr>
<tr>
<td>Days across diary period</td>
<td>-0.05</td>
<td>0.95</td>
</tr>
<tr>
<td>Level 2: Between-person</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average sleep quality</td>
<td>0.17</td>
<td>1.18</td>
</tr>
<tr>
<td>Age</td>
<td>0.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Relationship status (ref. single)</td>
<td>-0.23</td>
<td>0.79</td>
</tr>
<tr>
<td>Variance Parameters (Random Effects)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>0.96</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Daily sleep quality</td>
<td>0.17</td>
<td>0.18</td>
</tr>
</tbody>
</table>

*Note. AOR = adjusted odds ratio; CI = confidence interval; ref. = referent; CAS = condomless anal sex*
Figure 1. Conceptual model for three effects of tiredness on alcohol use or sexual behavior.

Pathway A proposes that tiredness lowers the odds of the risk behavior via increased lethargy and inactivity. Pathway B proposes that tiredness increases the odds of the risk behavior via impaired self-regulation. Finally, Pathway C proposes that tiredness increases the odds of the risk behavior via increased motivation or desire for the risk behavior.
Figure 2. Frequencies of those reporting drinking during the day, evening, night, or no recent drinking, N = 3696.
Figure 3. Percentage of men reporting peak drinking times by chronotype, N = 2814.
Figure 4. Percentage of men by chronotype reporting use of alcohol to stay awake longer, N = 927.
Figure 5. Number of afternoon surveys completed, N = 52
Figure 6. Participants’ odds of engaging in any alcohol use on a given day, N = 52.
Figure 7. Participants’ odds of engaging in heavy drinking on a given day, N = 52.
Figure 8. Percentage of men reporting times of last CAS and last sex with condoms with a casual male partner, N = 344. Red dotted lines indicate the four groupings of time: daytime (6am to 5pm), evening (5-9pm), night (9pm to midnight), and from midnight onwards (12am to 6am).
Figure 9. Participants’ odds of engaging in any sex on a given day, N = 52.
Figure 10. Participants’ odds of engaging in CAS on a given day, N = 52.
REFERENCES


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Lane, S. P., Carpenter, R. W., Sher, K. J., & Trull, T. J. (2016). Alcohol craving and consumption in borderline personality disorder when, where, and with whom. *Clinical Psychological Science, 4*(5), 775-792.


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